

PALMS, PASTURES, AND SWIDDEN FIELDS: POLITICAL ECOLOGICAL
TRAJECTORIES AND SOCIO-NATURAL TRANSFORMATIONS IN PEASANT
COMMUNITIES IN MARANHÃO, BRAZIL

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2002

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Roberto Porro

To Noemi, Felipe and Pedro

ACKNOWLEDGMENTS

I received financial support for doctoral studies at the University of Florida (UF) from the Nature and Society program of the World Wildlife Fund, Brazil (a program sponsored by USAID and the State University of New York); the Collaborative Research Network program of the Inter-American Institute for Global Change Research (IAI); the Inter-American Foundation Field Research Fellowship for doctoral students; the Tropical Conservation and Development Program at the Center for Latin American Studies, UF; and the Compton Foundation, through the Program of Studies in Tropical Conservation at UF. My special thanks go to these institutions and to the staff associated with them.

I extend my sincere gratitude for the theoretical and methodological support, and for the constant encouragement provided by my supervisory committee, with whom I learned and shared ideas during the research and writing of the dissertation: Dr. Anthony Oliver-Smith, Dr. Charles Wood, Dr. Marianne Schmink, Dr. Michael Heckenberger, Dr. Michael Binford, and Dr. Emilio Moran. Extensive thanks go to Drs. Peter Hildebrand, H. Russel Bernard, Stephen Perz, Nigel Smith, and Terry McCoy. I also thank Karen Jones, Patricia King, Margarita Gandia, Joe Savastano, and the staff at the Anthropology Department, and at the Center for Latin American Studies, UF.

I am deeply grateful to the families of José Soares, Milton Monteiro, and Ildo Lopes, who let me stay in their houses every time I visited Lago do Junco. Rather than the product of isolated field research, this dissertation is the result of more than a decade of close work with people in the Mearim Valley. Therefore, I would like to extend my

thanks to Raimundo Vital, Raimundo Herminio, Francisco Marcelino, José de Brito, José Maria Carneiro, Manoel Rodrigues, Manoel de França, Francisco Lima, Maria Adelina, Maria Alaines, Antonia Brito, and Leonice Pereira for the privilege of learning from the struggle of their lives. I am grateful to people working at ASSEMA, and particularly to Luciene Dias, Jaime Conrado, Carolina Mendes, Valdener Miranda, José Carlos Florêncio, Ronaldo Carneiro, Francinaldo Matos, Teresinha Alvino, and Ildeth Sousa.

I am grateful to the Prefeitura of Lago do Junco for providing valuable information. I thank Marildo Sousa, Maurício Ferreira, Agenor Nepomuceno, and Arlan Silva for the field application of survey questionnaires; and Adriana for transcribing interviews. For their help in the generation of maps and other documents, I thank Jim Sloan in the cartographic laboratory at UF's Geography department; and Henrique Mota and François-Michel Le Tourneau, in Brazil. I also thank Glen Green for his help with remote sensing procedures. For more than 15 years of work, support and friendship, I thank Alfredo Wagner de Almeida. I am also grateful to Kaye Pyle, Anthony Anderson, Peter May, Jorge Zimmerman, and Robert Wilson, who were close advisors in the transition between work in Maranhão and study and research in Gainesville. I also thank Joaquim Shiraishi, Karl Wirtz, Jean-François Tourrand, Domingos Dutra, Adolfo Themme, Eriberto Rembecki, and Klaus Finkan.

I gratefully acknowledge the support of Antonio and Ada Porro, Eugenio Caffarelli, and Shiro and Kazuco Miyasaka. Noemi shared with me college, work, graduate studies, life experiences, challenges, frustrations, and realizations. I thank Noemi and our children Felipe and Pedro for the everyday lessons I learn from them. I also ask them to forgive my mistakes along this trajectory.

PREFACE

The motivations to write on the events and processes that occurred in Lago do Junco go back to the onset of my professional career, and express an attempt to put a capstone on 15 years of shared experiences with the people and places that are much more to me than research subjects and research sites.

My introduction to Lago do Junco was in 1986. With a background in agronomy, I began a 3-year contract to assist peasant communities that had recovered tenure rights previously eroded in the wake of land conflicts that occurred since the 1970s. As it turned out, I lived in the Mearim Valley for 8 years, most of that time working in Lago do Junco, the municipality I returned to every year since 1996 to carry out research on the interplay between socioeconomic and biophysical change. In the course of 15 years of living and working close to the people of São Manoel, Pau Santo, and other villages, I witnessed firsthand the strategies adopted in their daily struggle to overcome internal differences, to deal with structural constraints, to cope with restrictions to access to resources, and in their struggle to survive the threats to the basis of their livelihood. That experience, in turn, had a profound influence on my sensitivity to and appreciation of the complexity of peasant social systems. The experience also highlighted the need to further understand the dynamic links between features of the landscape, and processes that influence land-use strategies, and socioeconomic stratification.

I moved with my wife Noemi and son Felipe to Maranhão in June 1986. I was 22 at the time, having recently graduated in Agronomy at the University of São Paulo. I had

no working experience in the field, except for a job I held in the previous 10 months, when I managed a dairy farm in the state of Minas Gerais. The farm was owned by a family member who had recently entered into the venture. However, overseeing a staff of half a dozen laborers to upgrade and make profitable those several hundred hectares was not exactly what I anticipated for a professional career. My undergraduate studies focused on rural sociology and agrarian issues, and I expected to engage in programs or initiatives that promoted land distribution. As Brazil had just entered the transition to democracy, expectations about the implementation of land-reform policies were on the rise. Even though the job on the farm was convenient, and fostered the belief that I was providing support for my family, the idea of taking a position overseeing a team of practitioners who were assisting peasant communities in their struggle to adjust to a new resource base was a challenge to Noemi and me.

The prospect of working in Maranhão was particularly attractive because it was precisely the state we had visited in 1983 and 1984 and had chosen as a future location to settle down and start a life together. Early in 1986, the Diocese of Bacabal in central Maranhão announced a search for an agronomist to direct a team of agricultural technicians. The duties were to assist peasant communities that had recently suffered violent dispossession from the lands they worked, and were then in the process of recovering their tenure rights. Upon meeting with the project director in São Paulo, we agreed to a short initial visit to the project region. During a 1-week visit in March of that year, I had the opportunity to attend one of a series of gatherings (*encontros*) of leaders of those communities. This took place in the city of Bacabal, where they planned a common strategy and produced a report to be delivered to state authorities. The articulate

narratives expressed by those 40 people impressed me from the start, giving flesh and flavor to discourses and information I had previously received only secondhand.

The gathering in Bacabal was my first opportunity to contact activist leaders of local rural workers' movements. During the meeting I asked permission to visit several villages in Lago do Junco. My visit to the community of Pau Santo was an even more striking experience, and turned out to be the key to my decision to take the job. Having just read Mario Vargas Llosa's "The War of the End of the World," the vivid accounts of Pau Santo's residents conjured countless similarities, thereby putting into historical perspective two very distinct contexts--the restrictions imposed on Lago do Junco's peasants, on the one hand; and the assault on 19th century libertarians from Canudos, on the other. In the few days of my first stay in Pau Santo, I toured the village and its surroundings, observing local land-use practices while listening to the narratives of Brito, Milton, Dáde, and other residents. I was told about the police brigade that assaulted Pau Santo in the winter of 1985, shooting to death an elderly man at the village's entrance. The government soon terminated the landowner's property rights, and the 1,000-hectare farm was formally transferred to the federal government for the implementation of a land-reform/settlement project to benefit local residents. The dramatic events I witnessed then prompted the decision that profoundly marked the next decade of my life.

Noemi and I moved from the Brazilian southeast to a location in Maranhão, which, as it turned out, was completely different from what we initially had in mind. Two years earlier we had visited fishing villages near the coastal city of Alcântara, across the bay from São Luís, the state capital. Instead, we ended up working and living in Lago do Junco, a town of 2,500-people surrounded by pastures and palms. The town was centrally

located within Bacabal Diocese, and was a 10-minute ride from Lago da Pedra, a larger city of 25,000-people; and site of the residence of German Franciscan friars, one of whom was the director of the project in which I became involved. By serving as coordinator of the agricultural team for the ACESA Project (Projeto Ação Comunitária de Educação em Saúde e Agricultura), I could live with my family in a house in Lago do Junco owned by the Franciscan friars that had been vacant in the previous few years. The largest residence in town, the house was built in the 1940s by the area's main political chief. It was sold to the Church in the 1970s, and until 1983 was used to educate and train young missionaries. For the next 3 years, the house was our home (where our second son Pedro was born), headquarters of the agricultural project, and lodging site for project members and visitors. It was also where Noemi and I exchanged visits and maintained rapport with leaders of the rural workers' movement in the area, which was critical to our acceptance during and after the period of land conflicts. The building also served as a focal point to formulate initiatives designed to promote conservation and the rational use of natural resources in settlement areas.

In the years after 1986, while Noemi participated in an educational project in the nearby town of Poção de Pedras, I had the opportunity to work and periodically visit dozens of peasant villages that experienced land struggles in the municipalities of Lago do Junco, São Luis Gonzaga, Lago da Pedra, Bacabal, Paulo Ramos, Vitorino Freire, Lago Verde, Lima Campos, and Esperantinópolis. In 1989, the local Catholic Church resisted the emergence of an autonomous social movement within its own structure. Noemi and I therefore helped form an independent although more restricted regional alliance. Organized by the local rural unions (Sindicatos de Trabalhadores Rurais), the

alliance was composed of leaders representing over 2000 households in some 25 communities involved in settlement projects in Lago do Junco, São Luis Gonzaga, Lima Campos, and Esperantinópolis. The 1989 founding assembly of ASSEMA (Associação em Áreas de Assentamento no Estado do Maranhão) took place in the Lago do Junco house. From then until 1994 we served as technical advisors for the newly formed organization, which operated out of the city of Pedreiras. ASSEMA was a grassroots movement as well as an institution that provided technical assistance, extension, and training services.

Initially, ASSEMA focused on the resolution of land conflicts, lobbying government agencies for peasant tenure rights, and more equitable distribution of resources. This approach was gradually broadened, on the one hand, by ASSEMA's initiatives concerning production and commercialization of agricultural and extractive goods (mainly rice, manioc, and babassu kernels) and, on the other, by ASSEMA's organization of women working with babassu. By 1991, local social movements active in the region included associations of producers in most settlement areas of the four municipalities, an agroextractive cooperative, and an association of rural women workers in Lago do Junco. The conservation of babassu palms within ranches, and local populations' access rights to those stands became the trademark priorities for the various institutions. Since 1992, peasants in Lago do Junco, São Luis Gonzaga, and Esperantinópolis were able to elect members of ASSEMA as their representatives in the municipalities' legislative. Yet, ASSEMA's main challenge was to find an alternative production system to meet the needs of hundreds of households struggling to survive in the region. Traditional slash-and-burn, swidden agriculture no longer met the needs of

most communities. Long-term sustainability was not guaranteed, even for the minority of households who recovered their tenure rights, as the resource base that they counted on was extremely poor compared to the abundance they first encountered in the 1950s.

By 1994, ASSEMA had developed a working strategy to address those critical issues, which was recognized by major funding agencies (Oxfam, The Ford Foundation, the Inter-American Foundation, and the German agencies Misereor and Bread for the World). They were nonetheless far from resolving the dilemmas at hand. Networks extended to an interstate movement of babassu nutcracker women (MIQCB – Movimento Interestadual de Mulheres Quebradeiras de Côco Babaçu, created in 1989), as well as institutions operating at broader levels. Examples of the latter included the participation of ASSEMA's directors from 1992 to 1996 in the directorate of the Rubber Tappers' National Council (CNS – Conselho Nacional dos Seringueiros), and from 1994 to 2000 in the executive council of the Amazonian Working Group (GTA – Grupo de Trabalho da Amazonia). ASSEMA's technical team numbered over 20 people including agronomists, agricultural technicians, accountants, extension agents, and educators. Access to governmental sources was obtained through proposals submitted and funded by the Environmental Agency (IBAMA – Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis) and the Agrarian Reform Agency (INCRA – Instituto Nacional de Colonização e Reforma Agrária). In 1993, Lago do Junco's agroextractive cooperative (COPPALJ) began to export babassu oil to Cultural Survival Enterprises and to The Body Shop to make health- and skin-care products.

Despite these achievements, and significant advances in social mobilization and capacity building, the search for sustainable resource-use strategies produced few

consistent results. Meanwhile, the transition from land conflict to settlement projects was underway, followed by the consolidation of tenure rights. The process introduced greater complexity to social relations within and among communities, as new issues found expression in peasants' discourses and practices. Unable to effectively act on those developments, and feeling the need to reflect on the processes I experienced during those 8 years, I decided to leave Maranhão in 1994 and search for answers in an academic environment. I left for the United States in June 1994, and my family joined me 3 months later.

Eight years in the United States produced its share of mixed feelings in terms of personal and family matters. Yet it was also an opportunity to observe and to be part of a distinct social environment that helped me assess past and present experiences. While at the University of Florida, I returned to the Mearim Valley in 1996-97 to carry out research for a master's degree in Latin American Studies. I examined peasant survival strategies and collective action; and once again became attracted to the political and institutional developments that affected the socioeconomic and biophysical configurations in Lago do Junco, and that held direct consequences for both the social and natural environments of peasant communities. Going back to familiar places and people with the benefit of the distance and the advantage of institutional autonomy created a new set of conceptual and methodological issues, while enabling me to approach old ones from a new perspective.

In 1996, I became involved in the scientific community that focused on the human dimensions of land-use/cover change in the Brazilian Amazon. My first concern was to increase the contribution of social science (particularly cultural anthropology) to this

applied agenda. Second, I noted the direct, untapped connection between that research agenda and processes taking place in babassu growing areas. The idea was to join my past and present experiences, taking advantage of a longitudinal view that combined the practitioner and researcher's viewpoint that characterized my own professional career. Insights from the Brazilian and American social systems furthered my motivation to take on another round of academic research, this time at the doctoral level in cultural anthropology. The new vantage point represented the opportunity to further my understanding of peasant social systems in Lago do Junco, notably how community actions and interactions with other sectors of civil/political society were embedded in (and contingent on) people's relationship to the natural environment.

Familiarity with people in the area gave me the opportunity to progressively experience and understand the problems and situations they were encountering. The experience enabled me to translate these concerns into research questions and theoretical formulations that drew on the existing literature. The long-term experience also helped me devise appropriate strategies to test and compare formulations through fieldwork. The main challenge of this undertaking was, therefore, to generate a final product that reflected the innovative concepts, methods, and theories in ecological and economic anthropology, but that was also well-attuned to contemporary issues at ground level. My goal is to provide a resource for understanding the human dimensions of global change research that might benefit the subjects of this study. Thus, I present a complex story, in which the personal and the scholarly are inevitably intertwined.

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KEY TO ABBREVIATIONS

ACESA	Ação Comunitária de Educação em Saúde e Agricultura
ASSEMA	Associação em Áreas de Assentamento no Estado do Maranhão
BNB	Banco do Nordeste do Brasil
BSRSI	Basic Science and Remote Sensing Initiative
CEB	Comunidade Eclesial de Base
CIPEC	Center for the Study of Institutions, Population, and Environmental Change
CNS	Conselho Nacional dos Seringueiros
COPPALJ	Cooperativa de Pequenos Produtores Agroextrativistas de Lago do Junco
GTA	Grupo de Trabalho da Amazonia
IAI	Inter-American Institute for Global Change Research
IBAMA	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis
IBGE	Instituto Brasileiro de Geografia e Estatística
INCRA	Instituto Nacional de Colonização e Reforma Agrária
INPE	Instituto Nacional de Pesquisas Espaciais
ITERMA	Instituto de Colonização e Terras do Estado do Maranhão
LULCC	Land Use and Land Cover Change
MIQCB	Movimento Interestadual de Mulheres Quebradeiras de Côco Babaçu
PROCERA	Programa de Crédito Especial para a Reforma Agrária
PRONAF	Programa Nacional de Apoio à Agricultura Familiar

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

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December 2002

Chair: Dr. Anthony Oliver-Smith
Department: Anthropology

Informed by the historical background on land-occupation and land-use in the Mearim Valley, Maranhão, this study examines the interfaces among changes in resource-use in areas of secondary babassu palm forests; and social processes in a region of consolidated peasant occupation and ranching expansion in the eastern Brazilian Amazon. The study compares socio-natural transformations in the communities of Pau Santo and São Manoel, in the municipality of Lago do Junco. Both communities were formed in the 1920s, expanded in the 1950s, and emerged from land conflicts in the 1980s, with most of their terrain converted into palm-pasture associations. The study examines the trajectories of land-use since land conflicts, and the resulting allocation of resources among agriculture, babassu extraction, and cattle ranching. It compares the forms through which pastures were reincorporated into fallow land for agriculture, and the contrasting ways in which cattle ranching has expanded in the two communities.

A narrative analysis of the socioeconomic and ecological dynamics, integrated with remote sensing and statistical techniques, indicate a greater availability of land and resources in Pau Santo, where less importance is given to environmental conservation, and lower levels of social mobilization and land-use planning exist. The reverse was found in São Manoel, where resources are scarce, but internal cohesion is higher. Residents of the latter community transferred to the post-struggle period principles of social organization established during the time of the land conflict. The analysis considers details that distinguish the environmental and the social histories of each community, but interprets these specificities within a broader conceptualization of relationships among human and social organizations, and the natural environment.

The theoretical orientation of the study integrates perspectives based on individual action, human-nature interactions, relational-rationality, the role of social structures, and practice theory. The resulting approach (grounded political ecology) conveys the notion of dynamic and interactive processes transforming social relations and the biophysical environment as constituent parts of the same integrated system.

The integration of palms, pastures, and swidden fields points to the complexity of socio-natural transformations affecting peasants in Maranhão. The analysis shows that the expansion of cattle ranching is likely to benefit better-off families in peasant communities. It does not exclude, however, the implementation of programs in support of those in the worst economic situation. Given palm/pasture ecological compatibility, and consensus over free access to babassu stands that was established in the region, the maintenance of pastures in lands within and around communities will favor the continuation of babassu as a key component in the livelihood of impoverished families.

CHAPTER 1

TRANSFORMATIONS OF SOCIO-NATURAL ENESEMBLES

The present study examines the trajectories and the interplay of resource-use and social stratification in a region of consolidated peasant occupation and ranching expansion in the eastern Brazilian Amazon. It focuses on interfaces among social processes and transformations in land- and resource-use in areas of secondary palm-forest succession in Lago do Junco, a municipality in Maranhão's Mearim Valley.

This study draws on the sub-fields of economic and ecological anthropology. The study analyzes practices, decisions, and actions of individuals as they face available resources within broader socioeconomic contexts. The emphasis is on interactions among human populations and their biophysical environment. Yet, as is typical of peasant studies, and also of land-use/cover change research, this is an interdisciplinary investigation that integrates approaches and insights from other sub-disciplines in anthropology, and from other fields in the social sciences. Given the nature of the study, I opted for a problem-centered approach—one that progressively examines a concrete case across disciplines, seeking to combine explanations from competing paradigms. The intent is to fill gaps in knowledge that result from boundaries within social sciences, and among social and natural sciences.

I argue that the study of interactions within ethnographically specific societies will shed light on broader trends in global environmental change. Specifically, I claim that the analysis of feedback effects among conditions of socioeconomic stratification and social organization within peasant communities on the one side, and landscape

dynamics and biophysical features on the other side, promotes an understanding of processes that affect human populations and their interaction with nature.

This research assumes that land-use/cover dynamics¹ integrate temporal, spatial, and organizationally specific choices, made by resource-users who operate within structural constraints. Resource-allocation decisions, therefore, are local responses to the conjugation of cultural, ecological, economic, historical, and political factors, often positioned at different levels within the system. Furthermore, these decisions comprise a continuum of domains of explanation with increasing theoretical abstraction.

Informed by the historical background on land-occupation, land-use, and concentration of wealth and landownership in Maranhão, this study examines socio-natural transformations in the communities of Pau Santo and São Manoel. Today, agro-extractive peasants in these communities interact with capitalist ranchers who own land in the region. Some of these ranchers arrived in the last quarter century. In several instances, however, the ranchers were peasants who since the 1960s have differentiated from their original group. Analysis of discourses and practices of these agents rejects the dichotomy between peasants and market-oriented ranchers as a valid representation of local reality, instead arguing for a more complex conceptual approach.

I claim that perceptions, discourses, and practices of peasants and ranchers about resource-use strategies are informed by varying degrees of relations of power within groups. Discourses and practices are further influenced by ideological orientations and by the form of their insertion into broader social formations. I intend to examine the

¹ Land-cover is “the biophysical state of the earth’s surface and immediate subsurface.” Land-use “involves both the manner in which the biophysical attributes of the land are manipulated, and the intent underlying that manipulation.” (McCracken et al. 2002:163-166; Moran et al. 2002:193). Resource-user and land-user are interchangeably used throughout the text, assuming that land refers to broader biophysical resources.

hypothesis that, in very polarized social situations, ideology strongly guides people's cognitive model of nature and resource-use. In the Mearim Valley, ideology is expressed through practices that determine land-use allocations. Such ideologies explain the opposing perspectives among peasant and ranchers concerning the dominant pattern of local land-use (the association of pastures and palms). Conversely, perspectives and preferences regarding the ideal landscape tend to be less differentiated when peasants recover their tenure rights and obtain greater access to resources. Furthermore, the comparative assessment of Pau Santo and São Manoel shows that neither agro-extractive peasants, nor market-oriented ranchers are homogeneous categories in terms of their respective resource-management strategies. In addition to the differential insertion of communities into broader political economic structures, specific features at the household and individual levels define producers' rationale, and consequently, define the predominant type of human/environment interaction that results.

The conversion of areas of secondary succession into pasture/palm associations is often associated with an apparent loss in ecosystem integrity. However, when proper management is employed, pasture/palm associations in Lago do Junco have lasted for more than four decades, with no significant loss in productivity. In this study, I argue that the integration of cattle ranching with the extraction of products from the babassu palm (together with shifting-cultivation) has improved the well-being of local households. This outcome is particularly evident when communities are able to collectively mobilize their labor and pool their resources. Even though the outcomes are still limited to relatively short time frames, the balanced integration of cattle herding with shifting-cultivation and babassu extraction has proven to be viable from both a social and biophysical standpoint.

A number of special features enhance the relevance of carrying out research in communities² in the easternmost part of the Brazilian Legal Amazon (see the location of Maranhão, the Mearim Valley, and Lago do Junco in Figure 1-1). Land in most of Lago do Junco and its vicinity began to be occupied and cultivated by peasants in the 1920s. Ranching made its appearance in the 1960s. The combination of the two activities provoked the deforestation of most of those lands by 1970. Yet, patterns of secondary succession promoted the expansion of pastures in association with babassu palms. Products extracted from babassu are important sources of monetary and nonmonetary income to peasants. The combination of pastures and palms allowed the reproduction of a peasantry near or literally within ranches. Since the 1960s, this arrangement and the use of natural resources by long-term squatters was threatened by the private appropriation of land, and restrictions imposed on agriculture and extractive activities. After a period of oppression, communities responded through organization and collective action in the 1980s that resulted in significant recovery of peasant tenure rights. The history of the events in the past heavily influenced present socioeconomic configurations in and around rural Lago do Junco, affecting the degree of internal cohesion within different localities, as well as the way that households interact with the landscape, and with one another.

The livelihoods of more than 300,000 households in Maranhão rely on products extracted from babassu. They primarily engage in small-scale, slash-and-burn cultivation in lands covered with babassu palms. In addition, the extraction and sale of babassu kernels carried out by women and children plays a major role in household survival strategies. Although changes in land- and resource-use characterized parts of the Mearim

² Later in this chapter I will distinguish between the concepts of village, and community. Chapter 2 discusses the concept of peasant, and Appendix B defines agro extractive/shifting-cultivator.

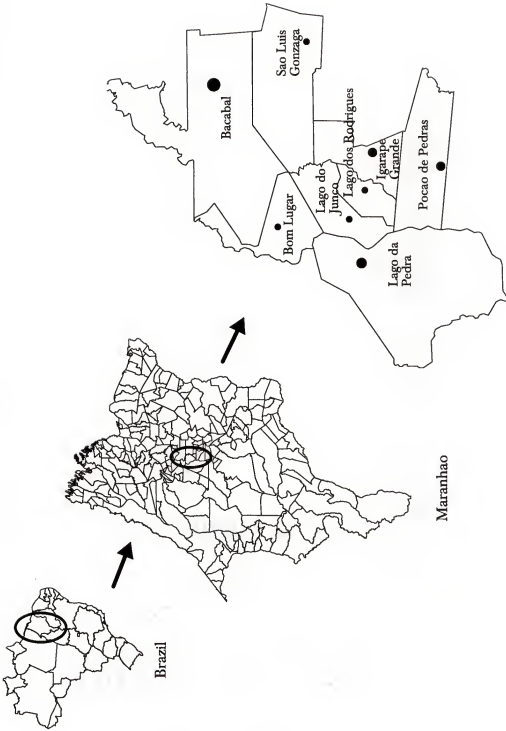


Figure 1-1. Location of Maranhão, the Mearim valley, and Lago do Junco

Valley since the 19th century, more intense processes occurred in the last five decades. Predominant vegetation cover changed from species-rich forests to secondary succession of babassu, to pastures containing palms of various densities. Pasture-palm associations have progressively covered the landscape in Maranhão, and a growing number of peasant producers integrate ranching into their economic strategies.

Maranhão's social indicators are among the lowest in Brazil. The state's human population density is the highest in rural areas of the Brazilian Amazon (IBGE 2001a). A large portion of colonists and squatters, and of migrant and landless families still arriving in other parts of the Legal Amazon³ are from Maranhão, or settled there for significant periods. As babassu forests are gradually observed in areas of later human colonization, the "babassu zone"⁴ of Maranhão presents a context where resource-use is undergoing significant changes that are likely to occur elsewhere in the Amazon.

Examining mechanisms that drive land-use in areas of consolidated human occupation (and their interaction with processes of economic differentiation and social stratification) will help identify policy alternatives that increase access to resources, provide tenure security, and improve socioeconomic conditions in the region. If effective, these policies can reduce demographic pressures to still-forested areas in the Amazon. Documenting land-use strategies in Lago do Junco will contribute to this objective. Last, careful analysis of the problems and achievements of people in Lago do Junco will refine theories of economic and ecological anthropology and link them to an applied anthropology agenda that focuses on the human dimensions of environmental change.

³ The Legal Amazon includes the states of Acre, Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima, Tocantins, and the state of Maranhão west of 44° W.

⁴ The "babassu zone" (the main area of occurrence of babassu) lies from 2 to 7°S, and 42 to 48° W.

This dissertation is organized as follows: in this chapter I discuss the approach, and the specific research question, as well as the methodological procedures used in the analysis. I also present the analytical framework that guides the research. Chapter 2 discusses the theoretical framework that integrates the domains of explanation for trajectories of land-use, transformations in land-cover, and their interaction with socioeconomic processes. The theoretical framework conceptualizes peasant societies, social stratification, and land-use dynamics as key components of this investigation. With these issues as a reference point, I present a revised, “grounded political ecology” approach that combines elements from the sub-disciplines of economic and ecological anthropology, and incorporates practice theory. Chapter 3 presents the ethnographic context and the sequence of processes and events that resulted in today’s socioeconomic configuration in the study area. Chapter 4 uses narrative analysis to examine biophysical conditions and the dynamics of resource-use along these phases. Chapter 5 critically uses remote sensing techniques to address transformations in land-cover, while Chapter 6 examines socio-natural trajectories through quantitative data collection and analysis. Chapter 7 discusses the social roots of the transformations and processes under study. Chapter 8 presents an in-depth analysis of the expansion of ranching in peasant communities of Lago do Junco according to the analytical and theoretical frameworks of this study. Finally, Chapter 9 discusses the policy and research implications of the findings of this research, focusing on the role of internally differentiated communities in the definition of future trends for socio-natural transformations in consolidated frontiers.

Broad Perspectives on Land-Use Trajectories and Human/Environment Interactions

Features of the biophysical environment impose constraints on agricultural and other subsistence activities. Practices used in a dry, shrubby landscape, for example, are

different from those used in moist, forested environments, even hypothetically assuming that all other socioeconomic and ecological variables remain similar. That assertion can be further refined to successive levels of analysis: within apparently similar moist and forested landscapes, for instance, specific features of soil and topography will constrain the range of activities or crops. Hence, since the origins of agriculture, a process of co-adaptation has occurred taking into consideration environmental conditions, the species available for domestication, and the ability of social groups to receive or import genetic materials or well-adapted practices. These processes of adaptation have included biophysical feedback effects that determine the suitability or not of subsistence practices. In the long run, these processes led human populations to identify forms of interactions with the biophysical environment that met their basic needs. Yet, it would be incorrect to assume that the search of humans for such ideal forms of interaction with nature has occurred in isolation from broader political economic forces.

It is well known that given certain environmental conditions, and accounting for centuries-long processes of co-adaptation and species domestication for agriculture and other subsistence activities across most of the globe, specific practices carried out by human populations are, to a great extent, influenced by cultural and political economic features that determine technological systems adopted by social groups, and the level of affluence they attain. Hence, although relations of power and economic inequalities within and among social groups have long been important factors that determine subsistence needs and influence human/environment interactions, the relevance of social structures and power relations has increased greatly.⁵

⁵ Yet, the effect of complex political and economic structures leading to environmental degradation at much wider temporal scales can be seen, for example, throughout the debate on the causes of the "collapse" of

For example, within tropical forests in the Amazon, it would be easy to identify multiple resource-use systems adopted by populations with distinct forms of social and political organizations and cultural orientations. Given this assumption, an opportune and challenging research agenda would consist of detailed investigations of indigenous and foreign (migrant) Amazonian cultures. Such research would focus on long-term processes that result in the identification of viable combinations of land-use strategies, and whether (or how) these strategies have been altered in the recent past. It is likely that findings of such research would show that, for most of the peoples studied, cultural ecological conditions of early inhabitants contributed to technological systems that produced limited ecological impacts, often absorbed through ecosystem's resilience.⁶

Conversely, in most of the Amazon the combination of political conditions, policy instruments, population dynamics, and related social structural developments in the last quarter century have threatened a number of the region's most recognized features, ranging from biodiversity conservation to the survival and social reproduction of indigenous cultures. Although the scope of this example is well beyond this research, the present study addresses similar issues. It is oriented by the need to provide an in-depth investigation of the factors that result in the dynamic adoption of specific land- and resource-use systems by people in a specific region in the Brazilian Amazon, integrating these systems' social and ecological outcomes.

Mayan and Andean civilizations (Adams and Cowgill 2001; Binford et al. 1997; Erickson 1999; Gill 2000; Tainter 1988; Yoffee and Cowgill 1988).

⁶ In ecology, the concept of resilience refers to the degree, manner and pace of restoration of the structure and function of the original ecosystem after disturbance, conferred by the collective effects of individual species of a community or landscape. The term includes not only the manifestation of recovery (Westman 1978, 1986) but also the maximum amplitude of disturbance that still allows the recovery (Holling 1973).

State policies promoting land occupation and market integration in the Brazilian Amazon were often thought to hasten deforestation and environmental degradation (Bunker 1985; Fearnside 1986; Mahar 1989; Schmink and Wood 1992). Although such policies and interventions did in fact lead to that end result, they cannot be dissociated from a mosaic of other complex biophysical and socioeconomic factors that influenced individuals and communities in the selection of their land-use strategies. Populations respond differently to stimuli produced by complex and dynamic associations of factors. It is appropriate thus to ask why certain groups tend to maintain traditional land-use systems based on extraction of non-timber forest products, cultivation of small vegetable gardens, and sustainable use of fisheries; while others engage in progressive deforestation for extensive agriculture and cattle ranching. The challenge presented here is to understand the various hierarchies and linkages involved in these processes.

Rather than reversing the priority given to political economic factors, we need to understand complex processes that influence the selection of preferred land- and resource-use strategies, and define the sequence of landscape trajectories. Instead of asking what comes first--the structural constraints imposed by state intervention and market operation, or the manifestation of human agency through conscious choices among given alternatives--the investigator needs to formulate a research design and a strategy that address the question according to multiple scales, perspectives, and domains of explanation. From this viewpoint I study land-use trajectories in Maranhão.

Approach and Methodological Procedures

Dissertation Approach

This study was driven by the need to bring empirical evidence to bear on a theoretical proposition concerning social and natural systems undergoing change. The

approach involves the participation of socio-cultural anthropology, combined with the applied research agenda on human dimensions of land-use/cover change. This approach expands the explanatory power of economic and ecological anthropology through the use of political ecology formulations, grounded with the incorporation of practice theory. According to the proposed analytical framework, the agency of resource-users is combined with structural determinants in responding to political ecological, socio-cultural, and biophysical features that influence land- and resource-use strategies.

An initial remark has to do with my previous experience in the region (mentioned in the Preface). I can affirm that several components of the present study benefited from the years I lived and worked in Maranhão. Some were only possible because of this experience. No systematic instruments of inquiry with the specific goal of collecting data for an academic research were carried out at the time. Yet, the importance of this unique situation went far beyond establishing rapport with the subjects of the investigation and getting acquainted with the local environment. Although the subjectivity of those past procedures, and my own direct stake in local developments while working in the area would fail to meet the rigor of certain scientific traditions, they nonetheless contributed greatly for the formulation and testing of the propositions presented here.

Fieldwork: Sites, Procedures and Basic Notions

Fieldwork for this research was carried out in Maranhão during three periods totaling 10 months in 1999, 2000, and 2001. In June 2002 I spent an additional 10 days in the area to clarify pending issues. I spent most of the time visiting communities in Lago do Junco. While in the city of Pedreiras I used office infrastructure of ASSEMA--the institution where I had previously worked. In addition, I traveled to São Luis, the state capital, to interview and discuss agrarian issues with state personnel, non-governmental

organizations, and with local academics. I spent four other weeks carrying out a parallel study⁷ in another area of the state, the Pindaré Valley, where I observed a social situation of more recent peasant occupation and shorter trends of forest succession.

I focused research efforts in Lago do Junco, and more specifically in two sub-sites of the municipality: Pau Santo and São Manoel. Each sub-site corresponds to a cluster of villages and communities near a settlement project.⁸ In this study, village (*povoado*) is a spatially bounded concept, where groups of rural houses are located relatively close to each other. Peasant villages in Maranhão vary in size, from extended-family-based neighborhoods of a few households, to hamlets of over a hundred families. They are often located at geographically privileged sites near water sources or roads. In addition to dwellings, larger villages include buildings for religious, educational, agro-processing, and commercial functions. Villages of 40-60 dwellings are common in Lago do Junco, at an average of 3-5 miles apart from each other; while smaller ones with 5-15 houses occur in between. Therefore, village is treated in this study as an inclusive concept for all people living in relative geographic proximity, with no cultural, economic, religious, or political segregation. It is a term that closely relates with conceptualizations in the literature on entities that continuously create “space” (Harvey 1996:261-4).

⁷ My stays in the Pindaré Valley were related to the participation in the research project entitled “Cattle Ranching, Land-use and Deforestation in the Amazon: a Comparative Study of Brazil, Peru and Ecuador,” a partnership among the University of Florida and seven other research institutions, funded by the Inter-American Institute for Global Change Research (IAI).

⁸ Settlement project (*projeto de assentamento*) is the terminology that Brazilian land agencies use since 1985 to name areas under agrarian reform interventions. A single terminology used at the national level, however, did not take into account diverse regional contexts. In areas such as central Maranhão, a substantial portion of these so-called settlement projects were installed on lands with long-term peasant occupation, although such settlements were often neither recognized nor legalized by government agencies. To refer to those families as “settled” in the land through such mechanisms isn’t accurate, even when one considers that peasant occupation was temporarily challenged through violence and the action of land speculators.

Conversely, the term community (*comunidade*) conjures a more relational concept of “place” (Escobar 2001). Besides more appropriately referring to interactions between inhabitants of a village with their physical location (the occupants of a space in a particular time), the term community in rural Maranhão reflects religious, cultural, political, and economic processes of differentiation taking place within villages. In short, a community is treated here as the site of relations among attributes of people who live in a village; and between them and the local environment, as well as the “permanences” produced by these relations (Whitehead 1920, quoted by Harvey 1996:293-5).

Settlement projects, by their turn, are policy initiatives carried out within the boundaries of landed properties. Their beneficiaries are expected to settle inside such properties, and eventually form their own villages and communities. However, in the field we observe that the beneficiaries (settlers, or *assentados*) do not restrict their living and working sites to these properties. These settlers are not the only ones working and living in the areas. Residency patterns that preceded most projects in the Mearim Valley, and demographic developments after their installation generated a situation in which communities include landless, small landowners, and even a few small and medium-sized ranchers living in social and geographic proximity to beneficiaries of settlement projects. To make the matter more complex, projects often carry the same name of nearby villages where beneficiaries reside (not always within the boundaries of the project), which is also the name of the religious community. Suffice it to say that the units of analysis for this study are individuals and households who, although members of peasant communities and residents of peasant villages, may be beneficiaries of a settlement project. Additional units of analysis are the common and private land properties used by these people.

Finally, the approach treats as units of analysis the clusters of communities themselves, comparatively assessed in regards to their socioeconomic and biophysical configurations.

The decision to carry out research in only one municipality, in addition to provide a better understanding of local processes of socioeconomic stratification and community organization, has enabled in-depth analyses of how these processes led to different outcomes under certain similar conditions. The study therefore “controls” for such variables as general biophysical characteristics, market and infrastructural conditions, the historical process of occupation, the occurrence of land struggles in the recent past, and the interaction with municipal governments and state land agencies. Both clusters include settlement areas, and a combination of other land tenure types: private small landholdings and relatively large ranches.

The first cluster is the community centered in the village of Pau Santo. Pau Santo is also a settlement area under the federal administration of INCRA. Five other villages belong to this cluster: São Francisco, São João, São José, Pau Ferrado, and São Sebastião. The second cluster is the community centered in the village of São Manoel, a settlement area under the administration of the state land agency (Instituto de Colonização e Terras do Maranhão, ITERMA). It includes the villages of Lago Queimado, Estirão, and Centro dos Custódios. The area of the clusters is respectively 4,200 and 1,440 hectares. Their boundaries were defined either by formal property rights, or by informal claims.

While at the study sites, I lived in the houses of two long-time acquaintances, with whom I used to stay since my visits in the 1980s. My hosts in Pau Santo and São Manoel were the families of Milton Monteiro and José Soares. The livelihood and social relations of these households within their respective communities are shown in Chapter 7. It is

opportune to mention at this moment that in most cases I used fictitious names for locations, and pseudonyms to preserve the identity of the subjects.

Methodological Protocols

The three major methodological components of fieldwork were: the ethnographic and interactive interviews with key informants; the application of socioeconomic surveys to all households within the two clusters; and the gathering of spatial data on landownership, land-use and land-cover. The approach used in the analysis was to integrate and compare qualitative, cultural information obtained through ethnographic interviews; quantitative, socioeconomic data provided by statistical analysis of the survey; and spatial data on land tenure, and on land-use/cover obtained through remote sensing and GIS. These data were then analyzed and used as evidence to validate the domains of explanation (discussed in Chapter 2) derived from the analytical framework for the study of socio-natural transformations.

Perceptions and experiences related to socioeconomic stratification, community organization, and resource-use were initially elicited through 32 semi-structured, interactive interviews. Although flexible, these interviews were planned to cover five general themes: socioeconomic conditions of the household, the practice of common resource-use, and the three main economic alternatives in the region: annual crops, babassu extraction, and cattle herding. Interviews were often carried out with the use of a tape recorder, and later transcribed either to a word processing program (by myself) or in handwriting by a research assistant.

Four research assistants were trained to apply a socioeconomic survey. All but nine (226 out of 235) households in both clusters were surveyed. Interviews lasted an average of two hours. The questionnaire (Appendix A) was developed in the spring of

1999 and pre-tested in July of that year with informants from a community not included in the study. Adjustments were made in the fall of 1999. The survey was then applied in the summer of 2000. Follow-up questions for the 2000-2001 agricultural year were applied in the summer of 2001. The survey includes sections on household demographics, and wealth and well being measurements, such as land-tenure, assets, consumer goods, quality of dwelling, consumption patterns, and market purchases. In addition, the survey collected data on the economic activities carried out by household members, and their additional sources of monetary and non-monetary income. A codebook was built, the data compiled to Excel spreadsheets, and then imported into SPSS for statistical analysis.

Land tenure, and landscape and vegetation characteristics (with emphasis on the dynamics of secondary succession) were based on exploratory field observations at the beginning of the dry season (July-August), with the participation of key informants from the communities. The acquisition of spatial data was an important opportunity for ethnographic research, by focusing on people's perception of major factors affecting land-use dynamics and environmental change. Spatial data on property boundaries and land-cover were gathered with a Garmin 12XL-global positioning system (GPS) receiver. Land-cover dynamics were analyzed through the integration of geographic information system (GIS) techniques and remote sensing analysis. The collection of such data included three separate stages: the field definition of property maps, including the boundaries of common and private landholdings; the gathering of sample (control) points for land-cover categories (to be used in remote sensing analysis); and laboratory work, carried out in the facilities of the Geography Department, University of Florida.

The method and protocols used in the remote sensing analysis are presented in Chapter 5, and in Appendix C. In addition, in Chapter 5, I critically discuss the implications of integrating satellite remote sensing and anthropological research in the study of socio-natural transformations. For the moment, it suffices to mention that throughout that discussion, I suggest that the extraordinary advances that have taken place with the advent and use of these technologies hold the promise of adding a great deal to social research. Yet the very power of these advances make it all the more important to be aware of the perils that may also be involved in their use.

Questions Concerning Resource-Use Trajectories in the "Babassu Zone"

Since my early visits to the Mearim Valley 15 years ago, what particularly caught my attention were aspects of interrelated political economic and cultural ecological systems pertaining to resource-use strategies. The first aspect was the marked cleavage between agro-extractive/shifting cultivator peasants, and market-oriented ranchers. It was also noticeable how strongly the core cultural-ecological features were associated with each of these groups. Some features related to shifting-cultivation of rice and babassu extraction. Others belonged to the realm of cattle ranching and pastures. These core features were viewed and assimilated as symbols of such a dichotomy. At that time, the adoption of either production system by the other group seemed not only unlikely, but was viewed as a transgression of their moral and ideological principles.

Second, in contrast to such a strong dichotomy, I perceived a low level of economic inequality among peasants. Sharp social stratification was not visible within those communities. Leveling mechanisms related to collective access and tenure rights, common resource-use, and other community-level institutions served to maintain limited internal inequality. In those circumstances, not only did the use of resources such as

palms, fisheries, grasslands, and even the individual cultivation of swidden fields occur under an apparent common orientation, but also the goal of obtaining private property itself did not appear to be a priority among peasants. A few peasants obtained land titles back in the 1960s and 1970s and resided on their properties. Most villages were instead inhabited by families who shared similar access rights to land and other resources. In most cases, those were long-term rights not recognized by the state, and challenged by recently arrived ranchers. In other situations, the expropriators were wealthier peasants who have become ranchers. When dispossessed peasants engaged in land struggles and recovered land tenure, most of them opted for common property rights.

Third, I did not see large differences in the predominant system of peasant production, even in light of increasing constraints imposed by resource scarcity. Indeed, agricultural and extractive practices appeared to be quite similar when carried out on the limited areas still forested, or in the predominantly degraded, long-term occupied lands. I was aware of the constraints on production possibilities imposed by severe land struggles. Yet, even peasant producers with consolidated tenure rights tended to have limited adaptive responses to localized population pressure on resources; and little concern with the depletion of these resources, and with environmental degradation. Consequently, there was little variation in the technology they adopted for subsistence.

Addressing the above issues in inverse order, the first set of questions I chose to deal with concerned the perspective from which peasants approached their subsistence activities. Did they perceive babassu extraction as a sort of last resort for the destitute? Was it an activity to be downgraded upon improvement of their socioeconomic status, or was extractive practice further justified through a more intimate linkage with their social

and cultural identities? If the latter were true, even though babassu extraction could be of lesser quantitative importance to household subsistence, it would always maintain an important qualitative role for their livelihood. Similarly, how would people contend with decreasing yields that resulted from the declining soil fertility of swidden fields cropped under shorter fallow periods? Shifting-cultivation is traditionally used in Maranhão as the main technological system to provide for peasant subsistence. However, population growth associated with the increasing concentration of landownership has been a threat to such system. Fifteen years ago I wondered about the extent to which local people would still use that technology. Would they be able to adjust their system of cultivation to a condition of limited resources, or would they introduce a more “efficient” technology? If the latter happened, what would they use to replace shifting-cultivation? Could that occur without peasant displacement by capitalist agriculture and relations of production? In sum, I wondered about the factors that influenced people’s perceptions, discourses and practices resulting in either maintaining or replacing traditional land-use strategies.

A second set of questions focused on the role of economic inequality, common resource-use, and community organization. My awareness of the conflictive context as heavily influencing households’ leveled socioeconomic status also applied to a strong process of community mobilization. It resulted in a unique opportunity to observe hierarchies and linkages among economic activities and economic inequality, the latter eventually leading to social stratification and class formation. I wanted to understand the extent to which the choice of economic activities would lead to economic inequality, and further to social stratification within the peasant group; and what other variables, if any, mediated this association. In addition, I questioned what would take place with

community mobilization once the initial polarization and conflict against outsiders were replaced by greater internal differentiations?

I did not pretend that the peasant social system in Lago do Junco functioned under radical collective principles, or followed the idealized communalisms advocated by the Catholic Church. Yet, an important question remained. Were egalitarian principles within peasant communities just short-lived, rational arrangements during land struggles, and therefore destined to disappear upon the resolution of the latter? Or would they last for longer time frames, the low levels of inequality and social differentiation indicating underlying redistributive features of the peasant social system?

I was further interested in the links between common property rights and resource-use strategies. In other words, babassu extraction and shifting-cultivation were compatible with common use of resources, while the introduction of technologies leading to agricultural intensification, for example, could collide with such tenure arrangements. My goal was to observe and understand which land tenure system would prevail in the event of agricultural innovations. The ultimate question was whether common tenure right was the desired target of peasant households, or would they convert common land to private property at the first opportunity? Alternative inclinations would be expected to have significant effects on people's interaction with their biophysical environment.

The third set of questions addresses the peasant/rancher dichotomy and its consequences for the incorporation of ranching activities within peasant land-use strategies. On the one hand I was inclined to accept and support peasants' derogatory view of ranching, blaming such activities for the concentration of landownership and heightened social injustices. Cattle ranching require more land than agriculture when both

are performed under extensive production systems. That fact provoked a feeling of relative deprivation among the vast majority of the rural population with little or no land, while confronting a small number of better-off individuals using extensive estates to raise cattle. These feelings were partially expressed through blaming the instrument of the expropriation, in addition to blaming the expropriators themselves.

On the other hand, I began to argue for a careful and unbiased examination of ranching itself, focusing on its comparative (or complementary) effectiveness as land-use strategy, regardless of political and ideological features it had acquired. My main argument for this reassessment was the characteristic of regional landscapes, and the apparent compatibility between palms and pastures accordingly managed (Chapter 4 has more details on this). Ranching was the basis for the economic stability of wealthier peasants in the 1960s and 1970s, and a substantial proportion of today's ranchers in the Mearim were better-off peasants of the past one or two generations.

More recently, I was convinced to further investigate this issue upon noticing that peasants themselves increasingly put aside previous judgments, and began to engage in ranching with satisfactory results. But as not all, nor even most of peasants did so, my concern was for understanding motivations and implications for the differential adoption of this trend. Further research could clarify the roles played by culture, social structure, rational decision-making, and the environment to this choice. In addition, benefiting from longitudinal analyses starting with processes of social stratification in the region, the unbiased examination of the contemporary expansion of ranching among peasants would contribute to better understand similarities and distinctions among social types in the area, and the appropriateness or not of the peasant/rancher dichotomized representation.

Inspired by the constant reflection provoked by these questions, I was convinced of the need to formulate systematic and comprehensive research protocols for the study of interconnected transformations in social systems and in the natural environment within which humans interact. These protocols, integrated under the analytical framework that guides this research, are presented next, while the theoretical bases for the formulation of a grounded political ecology are discussed in Chapter 2.

Introducing an Analytical Framework for the Study of Socio-Natural Transformations

The diagram in Figure 1-2 introduces the elements involved in land-use/cover change, and corresponds to the analytical framework that structures the design and goals of this research. In order to understand and represent social realities, the framework integrates domains of explanation that comprise a continuum of propositions at increasing levels of theoretical abstraction. By acknowledging and seeking explanations centered on individual action, human-nature interactions, relational-rationality, social structure, and practice theory, the framework does not take for granted pre-existing theoretical categories or propositions about universal causal mechanisms, or empiricist assumptions about the meaningfulness of probabilistic inferences. Guided by the integration and reinforcement of theories applied to concrete situations, the framework relies on historically-situated contingent hypotheses that address broader categories, and treat units of analysis simultaneously as independent contexts and comparable cases of a broader phenomenon (Sil 2001:530).

The critical components of the framework are boxes α and β , which depict two historical moments of a particular socioeconomic and biophysical context, or ensemble. I refer to the socioeconomic component as a “socioeconomic configuration,” defined as specific social relationships and related conditions through which individuals interact and

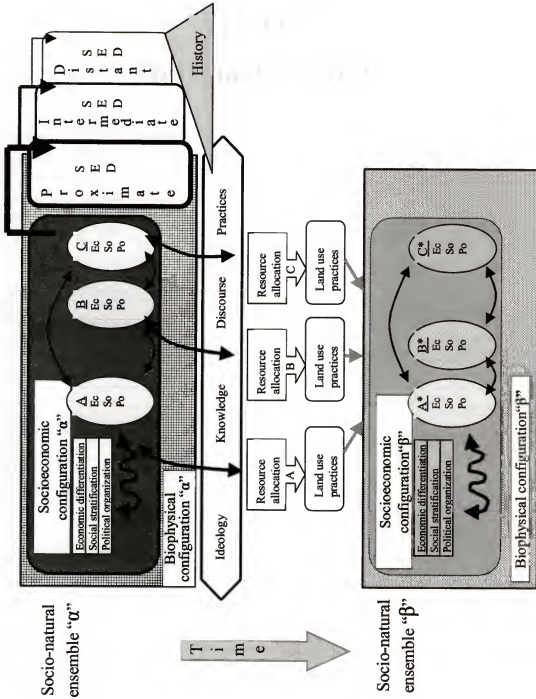


Figure 1-2. Analytical framework for the study of socio-natural transformations

produce goods and services. Similarly, elements of the natural environment are referred as “biophysical configuration.” Boxes α and β , therefore, integrate social and biophysical configurations at distinct historical moments, and are designated as “socio-natural ensembles” α and β .⁹

The material outcomes witnessed in the field, and the subjective dispositions of the actors within the social system, find their explanation in terms of the specific ways in which these two configurations come together at a particular point in time, and how the ensemble changes over time. These changes, in turn, are driven by a number of forces, some of which lie outside the boundaries of the specific cases being examined (such as state actions), and some of which are driven by the consequences of past social behavior, including the consequences of past social behavior for the environment itself (such as constraints introduced by the decision to convert forests to pasture). The analysis thus gives weight to the microscopic details that distinguish the natural and the social histories of each community, but interprets these specificities within a broader conceptualization of the relationship between humans and social organization, and the natural environment.

Although socioeconomic and biophysical configurations are continuously in flux and multi-dimensionally transformed over time, such transformations are schematically represented in the diagram by changes occurring from stage α into stage β . At the level of analysis employed in this investigation, boxes α and β represent, for example, two historical situations experienced within a community in Maranhão’s countryside with its constituent resource-users and respective resource-base. External boxes in α and β

⁹ Expanding Rudra Sil’s definition of context (2000), ensemble is defined here as “the interrelated, complex time- and space- bound conditions, events and sequences in which something exists or occurs, that are practically impossible to represent, let alone explain, in full.”

represent the natural environment that constitutes the biophysical configurations; internal boxes correspond to the respective socioeconomic configurations.

The interplay of natural environment and society is schematically represented in the diagram by the biophysical configuration encasing the internal box corresponding to the socioeconomic configuration (a *stricto sensu* analogy with concrete cases in which societies are positioned in particular biophysical environments). Biophysical conditions, however, are not viewed as the main formative aspect of socioeconomic configurations.

Assuming that socioeconomic configurations can potentially include distinct, articulated modes of production, they are represented by aggregations of individuals (in this particular case understood as resource-users), and the relationships among them. Resource-users' heterogeneity is symbolized by ovals A, B, and C, which correspond to individuals with unique features in terms of social status (S), economic conditions (E), and political power (P). The aggregate social configuration (at the level of communities or other institutions) will then be characterized by, among other things, particular conditions of social stratification, economic inequality, and political organization.

The level of analysis and the scale of the socioeconomic configuration being investigated will determine the heterogeneity of resource-users under examination, and their insertion in one or more modes of production. Suffice it to say that while certain analyses are limited to internal differences within a single category such as a peasant community, an indigenous tribe, or a band of hunter-gatherers, others may follow approaches that assess resource-use and social interaction across a broader array of analytical categories. In peasant communities, resource-use largely occurs through the economic activity of domestic units of production (households). The operation of these

units is influenced by their size and composition (household demographics). When resource-users are firms, corporations, or the like, other endogenous characteristics (such as management structure) will affect their specific resource-allocation.

Regardless of their nature, resource-users are typically related to one another through social relations and relations of production (depicted by curved arrows that link the ovals within internal boxes in ensembles α and β), and engage in activities through which they interact with the biophysical contextual components of the environment. The net result of such interaction are the outcomes identified in terms of resulting landscapes, aggregated and categorized in the diagram as “land-cover types.”

The framework departs from unidirectional formulations that treat changes in land-use and land-cover types as consequences of resource-allocation decisions by isolated individuals, households, or firms. Instead, it conveys the notion of dynamic and interactive processes that continuously transform social relations and the biophysical environment as constituent parts of the same integrated system, mutually affecting each other. Accordingly, nature (the environment, or the biophysical landscape) and culture (society, or the social relations linking individuals and groups) are embedded within aggregated representational contexts (socio-natural ensembles α and β) in which cultural components are both defined by and definers of the system (Buckley 1999:1135). Yet, the proximity and boundaries between biophysical and socioeconomic configurations vary according to the culture or population under examination, or even according to material conditions experienced by them. This is represented in the diagram by the variation in the thickness of the internal boxes encasing socioeconomic configurations, and by the gradient of filling patterns between the external (biophysical) and internal

(socioeconomic) boxes. These assumptions highlight the notion that integrated socioeconomic and biophysical configurations critically constrain (and provide opportunities that influence) the trajectories and choice mechanisms at the level of individuals, households, and firms.

Let us assume that stage α is the baseline scenario with given landscape features (and land-cover categories symbolized by the squared filling pattern of the external box in stage α). Stage α presents a configuration of social, political and economic elements that shape the prevalent relations of production. The result is conditions α with respect to social stratification, economic inequalities, and political organization. The latter are depicted in the diagram through the white filling of their respective text boxes. In addition, each resource-user in stage α experiences a singular configuration of social status, economic condition, and political power, represented by distinct shading patterns for ovals A, B, and C. The position of the ovals and the length of the arrows depict greater similarity in social characteristics between resource-users B and C in situation α .

Considering the socioeconomic and biophysical configurations, the framework approaches allocation decisions and land-use practices (by individuals A, B, and C, in the diagram), as attitudes that result from a conjugation of processes and patterns that can be assessed through distinct but interactive domains of explanation. The domains include the following:

- Rational responses of individuals to the influence of socioeconomic variables (driving forces, or drivers) operating at distant, intermediate, and proximate scales.
- The effect of biophysical characteristics, and of particular ways through which people relate to their environments.

- Responses of individual resource-users to their respective economic conditions, social status, and political power, when assessed in relation to other individuals and groups.
- The cumulative effect of historically-specific social formations that structurally constrain human action through the integration of socioeconomic and natural processes.
- Resource-users' agency in the interpretation of social-structural conditions and conditions presented by nature, as mediated by ideology, knowledge, discourses, and ultimately by recursive practices of this society.

Heterogeneity of resource-users within each socio-natural ensemble produces diversified responses to incentives and constraints presented through (and explained by) the above-mentioned domains. This leads to differential resource-allocation decisions and practices, and varied landscape trajectories (for A, B, and C in the diagram). These decisions and practices will produce, at a subsequent stage β , a modified biophysical landscape, transforming land-cover types, as symbolized by the lighter filling of the external box in ensemble β . The multi-directionality of this conceptualization resides in the fact that transformed land-use practices, and changes in the resource base, have the potential to continuously act upon pre-existing characteristics of resource-users and their socioeconomic configurations. Such recursive effects may alter power relations, social status, and economic conditions, and thereby modify social relations and relations of production, contributing to reinterpretations of the social and natural contexts.

In this instance, compared to stage α , the ensemble in stage β is depicted as more similar (smoother distinctions between filling patterns of external and internal boxes) and with thinner boundaries between the biophysical and socioeconomic configurations. The latter corresponds to situations in which the biophysical environment is subject to more intense human activity, and thus, more similar to the socioeconomic domain. In other words, landscapes in stage β are more anthropogenic, or "socialized" than in stage α .

As ensemble β shows, changes in the aggregate conditions of economic inequalities, social stratification, and political organization (depicted by the gray filling in their text boxes) are articulated to--and to a great extent are the result of--transformations in the economic, social, and political configurations experienced individually by resource-users. Such transformations are schematically represented in the diagram by changes from ovals A, B, and C in ensemble α , to ovals A', B', and C' in ensemble β (with their respectively modified filling patterns). In addition, ensemble β depicts a transformed social positioning for B', which is now closer to A' and further from C'. Among domestic units of production, time also transforms household demographics, imposing new sets of priorities and orientations for their resource-allocation.

A key aspect of the applicability of this framework to social science research is to accurately address the interfaces and cross-scale dynamics between the various domains of explanation that may be operating. The understanding of complex links of causality among allocation decisions, biophysical patterns and trajectories, and socioeconomic processes at work relies on meeting the challenge of considering aggregate and complex socio-natural ensembles--boxes α and β in the diagram--with their socioeconomic (including the political, economic, and cultural dimensions) and biophysical configurations. Moreover, it relies on the ability to disentangle the main features and relationships of these components that produce the observed contextual outcome.

The application of this approach to concrete anthropological investigations implies a focused presentation of the ensemble under examination according to the research problem. The analysis begins with understanding the operation of existing relationships within (and between) the individual and the socio-structural, as well as the

biophysical and the socioeconomic components of the target context. We then proceed with further analyses that incorporate progressively more distant temporal (historical) and spatial hierarchical levels.¹⁰ Building on these assumptions, it is essential to recognize that, as the research agenda progresses along analytical levels in a hierarchical system, certain domains of explanation are not always captured by positivist scientific traditions of hypothesis testing. The framework presented here is inspired by the notion that answers to fundamental questions on human/environment interaction should be sought through a continuum of research strategies that operate at distinct levels of abstraction. The options range from statistical analysis and modeling to interpretive approaches, which are informed by varying epistemologies, objectives, and levels of generality. Next, the proposed analytical framework is applied to the concrete case of socio-natural transformations that affected peasant communities in Lago do Junco.

Applying the Framework to the Study of Socioeconomic Stratification and Resource-Use Trajectories in Pau Santo and São Manoel

In this study, socio-natural ensembles α and β represent the socioeconomic and biophysical configurations of Pau Santo and São Manoel, respectively in the mid-1980s and today. These ensembles correspond to two very different periods in the social existence of the communities. While land conflicts and peasant dispossession by ranchers peaked in the early-1980s, socio-natural ensembles α signal the entrance of these communities into a stage marked by the recent recovery of peasant tenure rights, which coincidentally corresponds to the end of the military regime in Brazil. Socio-natural ensembles β , on the other hand, assess the conditions operating at the onset of the 21st

¹⁰ Theoretical formulations of a grounded political ecology, to be presented in Chapter 2, will inform this approach by not making a priori assumptions about the links of causality, and will reinforce the argument

century, a period of greater democratization and institutional development. Although democratization did not fully achieve land distribution, the dichotomy and polarization between peasants and ranchers that existed up to the 1980s is significantly smaller in today's situation. Therefore, protocols adopted in this research aim to unveil the socio-natural developments in this one-and-a-half decade during which, at least for the case of Lago do Junco, a new set of constraints to the livelihood of peasant communities (the post-struggle ensemble) replaced the more directly violent and ideological confrontations among peasants and ranchers (the pre-struggle ensemble).

In general terms, biophysical conditions that prevailed in the first period were the dissemination of jaraguá pastures in both settlement areas and surroundings. Little land was left in advanced secondary succession, which resulted in scarcity of areas for shifting-cultivation. Two relevant changes seem to have occurred in these 15 years. First, the progressive replacement of brachiária for jaraguá pastures in large and medium-sized ranches. Most importantly, a significant process of re-conversion of land from pastures to secondary growth took place on properties where peasants recovered tenure rights. These areas were then reincorporated into the stock available for shifting-cultivation. This reincorporation, however, was done differently in each area. One of the objectives of this examination is therefore to identify the causes of such differences, and explore their possible consequences. In particular, the analysis focuses on land-use trajectories that either privileged or disrupted the continuity of babassu extraction, through its integration with shifting-cultivation, and, mainly, its association with cattle herding.

that the research focus is not the isolated land-use or land-cover transformation per se, but the complex relationships which produce those outcomes within specific socioeconomic configurations.

Although apparently limited to 15 years, the present examination takes into consideration the historical context that, since the 1920s, has been influential to the trajectories of rural people in Lago do Junco. Indeed, as with the spatial scale involved in the analysis that goes beyond the boundaries of Pau Santo and São Manoel, the temporal scale being considered is significantly expanded to include successive events since the formation of a peasantry in the Mearim Valley, and the initial establishment of these villages. While the topics presented below will be developed in greater detail in other chapters, the following presentation introduces major aspects of the multi-dimensional transformations that have affected the socio-natural ensembles in Lago do Junco.

Rational Responses to Socioeconomic Variables Operating at Multiple Scales

As proposed in the analytical framework, socioeconomic drivers affecting practices of resource-allocation in the study area operate at multiple scales, from global to very local ones. The multiple scales that constitute the framework will be exemplified in the case study of Lago do Junco through the influence, in household resource-allocation, of gender relations within the household, community organization, the action of state and federal governments, and the interference of international markets.

Gender relations within the household

Transformations in land-use and in the landscapes being studied are highly related to household relations that constructed a complex gendered division of labor that acknowledges variations in land- and resource-use according to positions of the household in particular socioeconomic configurations, and along with specific demographic characteristics. Moreover, the maintenance of dense palm-stands associated with agricultural and livestock undertakings responds to the call for a balanced

participation of men and women in providing for household needs (see also Miyasaka-Porro 1997).

Community organization

Next in the hierarchical scale of socioeconomic factors affecting resource-use is the role of community mobilization, manifested, for instance, by changing peasant demand for shifting-cultivation through collective processing and trading of local production. In areas where land is not yet a constraint, peasants do not necessarily crop larger fields in direct response to their consumption needs, nor as an expression of their desire for accumulation. Rather, in situations that are still observed in the southwestern portion of the Mearim and Grajaú valleys, the cropping of large fields, and the sale of most of what is harvested, represent alternatives peasants can count on to cope with the exploitation imposed on them by merchants (Porro 1997:296). Conversely, fields remained comparatively smaller when community mobilization served to purchase local production and provide basic supplies at lower costs, and the acquisition of equipment for the processing of rice and manioc that further enhanced local terms of trade. As shown in Chapter 4, lower requirements for the size of swidden fields allow fallow schedules that improve the use of biomass provided by babassu leaves. Although several communities in the Mearim Valley had their land- and resource-use significantly altered by processes carried out at the community level, such alterations were not always positive, as in cases where internal tensions and competing leadership resulted in mismanagement of resources. Indeed, the nature of future socio-natural ensembles in the area will depend on priorities given to individual undertakings after the recovery of tenure rights by peasants, and the often associated processes of social stratification.

State policies

In the case of communities that are the object of a settlement project, resource-allocation decisions, and their impact on the local environment, are to a great extent related to governmental policies. Households and communities receive differential treatments according to their categorization by the state. In this context of unequal treatment, the provision of subsidized rural credit or other financial programs is one of the main factors resulting in landscape alterations in areas of localized agrarian reform. In parallel with the observed trend of re-conversion of land from pastures to secondary growth, when external resources were allocated to productive activities in settlement projects in the Mearim Valley, governmental policies were mainly channeled to pasture recovery and stock acquisition. Although settlement projects initiated as early as 1982 are still under way, there is conjecture in INCRA over the emancipation of older projects to constitute autonomous units and forgo preferential treatment from the government. Whether peasant producers will remain on the land and maintain their agro-extractive system of production once the “settlement” process ends is an intriguing question.

Local effects of a globalized economy

The effects of a global economy on the landscapes in the “babassu zone,” and on the livelihoods of agro-extractive/shifting-cultivator peasants, are also pronounced. Although constituting the basis for the livelihood of near one million people, babassu extraction recently lost even the modest government support that it received until the early 1980s. Industrial and agricultural developments replaced babassu oil by synthetic products in the food, cosmetic, and hygiene industries. Babassu and cottonseed oils were the most consumed edible oils in Northeast Brazil until the 1970s. Today, babassu oil maintains a small portion of this market, as it was replaced by soybean oil. In the 1990s,

soybean plantations were installed in southern Maranhão, supported by state projects with Japanese cooperation. In 1995, the Brazilian government reduced import tariffs for vegetable oils from 18 to 2%. This measure allowed increased imports of plantation-originated lauric oils (from palm, palm-kernel, and copra) from Southeast Asia, and particularly from Malaysia. The imports replaced extractive-based peasant production of babassu oil, and further undermined the incentives for babassu extraction.

The operation of multiple-scale drivers affecting resource-use trajectories in Lago do Junco also shows that these scales are linked through combinations that do not always reinforce hegemonic trends and hierarchical orders. This is exemplified by the localized dimension of a global economy, which in this case attenuates the effect caused by hegemonic trends of global capitalism. Since 1993 the Agro-extractive Cooperative of Lago do Junco (COPPALJ) sells babassu oil to the UK-based The Body Shop. Through this partnership, the cooperative has been able to raise the price paid to all the extractors for each kilo of babassu kernel by an average of 25% (\$0.36/kg in February 2000). In addition, since 1999 the cooperative has been redistributing financial profits among its more than 100 members. Beyond that, alliances with non-governmental organizations, cooperation agencies, and the engagement in “fair trade” transactions have been important arenas for the spread of the struggle of agro-extractive/shifting-cultivator peasants in Lago do Junco. Although restricted to one small municipality in Maranhão, this initiative illustrates the extent to which the agency of these peasants in the dynamic generation of practices directly interferes in resource-use, and in landscape trajectories. Such an outcome, however, is partially due to the interplay of factors that operate according to other domains of explanation, which are presented next.

Biophysical Features and Human-Nature Interactions

The predominant presence of babassu in secondary succession formations in the Mearim Valley, and the recent history of land-use in the area, are important factors that influence resource-allocation decisions today. Strategies and practices adopted by peasant producers considered the cumulative knowledge acquired, not only from their own agricultural and extractive experiences, but also from the observation and learning of the management systems adopted by ranchers. In the pre-struggle period, most of the land in and around both clusters was converted into jaraguá pasture (*Hyperrhanya rufa*). In the post-struggle moment, peasants were compelled to adopt practices to reconvert the landscape to forms that would allow their habitual form of interacting with nature, mainly with respect to agricultural undertakings. These forms consisted of patches of fallowed fields at different stages of regrowth, after the cultivation of roças. At the same time, however, people were attentive to the opportunity to maintain the integration of palms within pastures, as they perceived such association as advantageous to babassu extraction. In addition, jaraguá pastures were not viewed as an impediment to eventual flips of the landscape back to the agriculture domain. Major differences in land-use trajectories that peasants adopted in the post-struggle were, therefore, with respect to the relative weight given to these two alternatives. Chapter 4 discusses the contrasting trajectories adopted in Pau Santo and São Manoel. The fact is that the presence of babassu palms in the landscape, and the use of babassu-friendly jaraguá grass as the predominant species in planted pastures since the 1960s, are relevant drivers that defined present land-use strategies and land-cover outcomes.

“Relational Rationality” Perspective

A great deal of social interaction permeates day-to-day practices in communities in the Mearim. Attitudes and decisions of individual resource-users in these communities, therefore, are far from being the outcome of isolated agents who maximize their benefits given a conjugation of socioeconomic and biophysical factors. The notion of economic rationality adopted here includes a continuous and dynamic reassessment of social relations that are directly and indirectly implicated in the attainment of specific practices. Patterns of habitation in Lago do Junco's peasant communities, traditional systems of labor exchange for agriculture, and practices related to the performance of babassu extraction, all promoted repeated contact among villagers. In addition, the still recent history of economic differentiation and social stratification allows interactions across social classes. General conditions of social relations within and among communities; and among communities, ranchers, and power-holders, influence resource-allocations. Chapter 7 compares the role of extended-family-groups and kinship networks in Pau Santo and São Manoel for collaborative land-use initiatives. Another instance of the relational perspective can be observed through changes in the way cattle herding has been assessed by peasants after the resolution of land struggles, examined in Chapter 8.

Social-Structural Determinants

Departing from explanations based on individual attitudes and choices, even when relational perspectives are considered, the framework also explains trajectories of resource-use and land-cover outcomes through constraining structures of the social system. Indeed, for the case being examined, the definition of activities that are adopted today by peasant producers cannot be dissociated from the legacy of hierarchical power and authoritarian social relations in rural areas of a state in the Brazilian Northeast. In

Chapter 3, I will examine the historical components that have shaped the formation of the peasantry in Lago do Junco, subsequent moments of economic differentiation and social stratification, and recent transformations in structural elements of this society. The discussion emphasizes that alternatives presented to peasant communities to allocate their resources have been constrained by the operation of mechanisms of exploitation that included commercial extraction, the violent dispossession of people from their land, and the subsequent charging of rent. The succession of such mechanisms resulted in highly concentrated conditions for wealth and landownership, only attenuated by the partial recovery of peasant tenure rights in the late-1980s. These latter developments attest that certain structural constraints, though still restrictive, can be modified, resulting in an increase in production possibilities, and consequently, in land-use/cover outcomes.

Interpretation of Transformative Practices

Recent events in Lago do Junco provoked contrasting perspectives by which local resource-users perceive economic alternatives in their discursive and practical domains. Certain dispositions that were hitherto hegemonic according to local peoples' relational standpoint began to be undermined by their own tangible acts. This discontinuity between discourse and practice is manifested in the objective conditions of babassu extraction, and in the changing assessment of cattle ranching. Years of practice of babassu extraction, under conditions that resulted from the conversion of most of the land to pasture, are experiences that have been incorporated into the constitutive reality of women working with babassu. This incorporation provoked a duality in their social positionality. On the one hand, women still maintained their discourse, being vocal on behalf of the reconversion of land to a forested domain, and against pastures as the predominant landscape. On the other hand, the relative effectiveness of babassu extraction within these

pastures solidified the reproduction of a practical consciousness that contradicted their discourse. Hence, the ability to sustain a double standard is a proper example of the nonlinearity of processes and events that surround socio-natural transformations, mainly those affecting peasant societies. This non-linearity will be addressed through the course of the present research. However, before directly addressing the case study of Lago do Junco, Chapter 2 presents the theoretical foundations of this work.

CHAPTER 2

THEORETICAL FRAMEWORK: A GROUNDED POLITICAL ECOLOGY FOR THE STUDY OF SOCIO-NATURAL TRANSFORMATIONS

The analytical framework presented in Chapter 1 considers allocation decisions and land-use trajectories that result from a conjugation of processes and patterns, which can be assessed through distinct but connected domains of explanation. According to this proposition, research that aims to understand the interplay of transformations in the socioeconomic and biophysical configurations should comprise a continuum of approaches cast at different levels of theoretical abstraction or historical visibility. Such research should thus address the dynamic and interactive processes that transform social relations and the natural environment as constituent parts of the same integrated system. The main challenge to unraveling the complex links of causality among resource allocation decisions, biophysical trajectories, and the socioeconomic processes at work must take into account the aggregate and complex socio-natural ensembles, and disentangle the main features and relationships that produce the observed outcomes.

In this chapter, I expand the component parts and present the theoretical bases that form the domains of explanation of the analytical framework. This examination precedes a theoretical discussion on three key elements in this study: conceptualizations of the agents of the socio-natural transformations being examined; and the concepts of socioeconomic stratification, and land-use dynamics. In the conclusion of this chapter, I integrate these concepts, and the theories used to formulate a “grounded political ecology” approach for the study of socio-natural trajectories and transformations.

Multidimensional Analysis of Socio-Natural Transformations

In line with the framework presented in Chapter 1, I discuss below the multiple dimensions, or domains of explanation used to assess transformations in socio-natural ensembles. In this theoretical discussion, I was inspired by the combination of three major propositions. First, I borrowed from David Harvey's basic framework that represents the integration of social processes and distinguishes among its constituent "moments" (Harvey 1996:78-83). Second, I benefited from reading the recent work of Gunderson and Holling (2002) on the study of transformations on human and natural systems. Third, I drew on Richard Wilk's treatment to the relationship and integration among models of human behavior based on neoclassical economics, political economy, and cultural economics (Wilk 1996). The five domains that compose the framework (rational, ecological, relational, structural, and interpretive) must be approached as constantly interacting. My contention is that we can assess the combination of these domains to obtain a better understanding of socio-natural transformations. Although such transformations are the product of combined events and processes explained by these five domains, I argue that the framework does not preclude situations in which one of the domains assumes a primary role. Such primacy, however, varies on a case-by-case basis and has to be captured through multiple instruments of inquiry.

Rational Domain: Individual Responses to Nested Sets of Socioeconomic Variables

Centered on the study of behavior and models of decision-making, rational-choice principles proclaim that individuals act as if they were rationally observing existing configurations of variables, weighing costs and benefits of alternative actions, and as if their choices maximize their net utility. Analyses based on rational-choice also assume perfect knowledge of alternatives and that, in the aggregate, the sum of individual actions

will maximize social outcomes. While the nature of benefits that individuals aim to maximize is the subject of distinct theoretical appraisals, the emphasis of the first explanatory domain is on allocation decisions based on configurations of socioeconomic variables operating according to hierarchical principles.

Figure 2-1 shows the influence of variables designated as socioeconomic drivers (SED) on resource allocation. These socioeconomic drivers are hierarchically conceptualized as operating at proximate, intermediate, and distant spatial and organizational scales. The three-tiered distinction conveys the idea that drivers that operate at one level are nested in contexts that operate at higher levels of the system. Borrowing concepts from hierarchy theory in ecological systems, this domain of explanation assumes that, on the one hand, decisions and processes taking place at higher (slower, and coarser) levels construct the context for decisions and processes occurring at lower (faster, and more refined) levels (Ahl and Allen 1996:103), influencing “to some degree” the events that occur within respectively lower tiers in the system. On the other hand, it recognizes the mutually reinforcing relationships through which attributes of the higher levels emerge from experience of the lower ones, each level communicating a small set of features to the next higher level (Holling et al. 2002:72).

This portrayal is intended to capture the notion that land-managers are economic agents who determine how to allocate the resources at their disposal by engaging in complex decision processes that take into account the opportunities and constraints presented to them by proximate socioeconomic drivers. These decisions, however, are mediated by collective social action at the local level, and progressively encompass higher levels of social organization, larger areas of geographic coverage, and longer

temporal horizons with respect to the processes at work, which, in turn, are continuously transformed by human action.

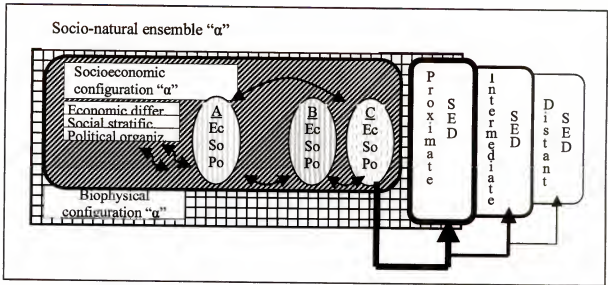


Figure 2-1. Influence of nested socioeconomic drivers on socio-natural transformations

To show variance in the strength and speed that distant, intermediate and proximate levels have on resource allocation decisions, the diagram relies on lines of varying thickness. The trajectory from distant to proximate levels is represented by boxes encased by progressively thicker lines indicating stronger, more rapid and direct effects as one conceptually descends from global to local levels. Although it is assumed that processes that take place within a lower level produce changes that are either too small or too fast to be much more than background noise in measurements of processes at a higher level (Gibson, Ostrom, and Ahn 2000), the framework does not preclude reverse causality. This is indicated in the diagram by return arrows, from configuration α to the three tiers of the system. It is likely, however, that the strength of such feedback effects progressively weakens as one moves from lower to successively higher levels. To show variance in the strength and speed of feedback effects, the diagram also relies on arrows of varying thickness, the denser ones indicating stronger, faster, and more direct effects.

The three-tiered hierarchy is a heuristic device, meaning that the focus on three levels is intended to be suggestive rather than definitive. Instead of invoking the realist notion that the model shows what actually exists in the world, the approach is to be treated as an abstraction or point of view that can be adapted to different phenomena, some of which may call for more or fewer tiers in the hierarchy. Similarly, the variables presented below are intended to be illustrative of the kinds of factors to be taken into account rather than a complete and finite set of variables. That being said, the three-tiered hierarchy nonetheless reflects the familiar micro, meso, and macro scheme, and is sufficiently detailed to encompass the main arguments that have been advanced to explain the process of land-use and environmental change (Wood and Porro 2001:15).

Proximate socioeconomic drivers include a host of variables that operate at the local level. Local levels of analysis can be a specific site, land-plot, or farm, or even a community, village, or town. Cultural norms are typical examples of these local-level drivers. Other variables that are often considered as proximate socioeconomic drivers are those that directly affect economic behavior, such as transportation costs and access to local markets, local wage rates and opportunities for off-farm employment, credit availability; tenure security, input costs; and prices for crops, livestock, timber and nontimber forest products. Other proximate socioeconomic drivers include the operation of local governments, the availability and introduction of technological advances, and local demographic patterns.

Intermediate socioeconomic drivers operate at broader scales. Examples include regional or national development policies (special credit and tax incentives), integration policies based on infrastructure investment, and initiatives such as colonization schemes.

Other examples are national security concerns, modernization trends in the country; and environmental and agrarian laws and regulations, including policies for natural resource conservation. Macroeconomic variables such as the external-debt crisis, fiscal deficit, inflationary spirals, and monetary policy are also included in this set.

Distant socioeconomic drivers operate at continental or global scales. This is the case for exchange rates, international commodity prices; and broad transformations in the world system, such as deepening economic globalization and world trade agreements, and the worldwide concern about "the environment." Examples of treaties and protocols at the global scale include the ones celebrated at the 1992 Earth Summit, and the 1997 Kyoto-Protocol to the United Nations Framework Convention on Climate Change. A concrete case is the Clean Development Mechanism (CDMs), a cooperative instrument through which developed countries, to meet part of their commitments, could use certified reductions in carbon emissions from sustainable development projects in developing countries.

The operation of multi-leveled socioeconomic drivers denotes the effect of exogenous categories, or variables, on empirical contexts. Yet, the extent to which these variables influence resource-use does not always correspond to internalized, fundamental conditions that guide individuals and groups. In other words, taken alone they are not incorporated as structural properties of the social system of which they are part. In some instances it can be acceptable to reduce processes and phenomena occurring at various levels of analysis to the ultimate interplay of facts and events at a lower level. But this condition cannot be generalized. Contextually specific allocation decisions will thus aggregate explanatory domains, relationships, and emergent properties at progressive

analytical levels. These interactions are rather more complex than the combined influence of socioeconomic drivers alone. Therefore, in order to explain resource-use allocation, I use the framework to incorporate the effect of these factors into higher levels of abstraction, through which particular aggregations of categories contribute to define individual perceptions of structured socioeconomic configurations in historical-specific contexts. The next domain of explanation to be presented focuses on human/environment interactions, and emphasizes the characteristics of the biophysical environment.

Ecological Domain: Human Interactions with the Biophysical Environment

The notion that environmental factors determine social and cultural features (or environmental determinism) is condemned in contemporary ecological anthropology research. Empirical observations have undermined the assumption that relevant cultural features are invariably adaptive to environmental conditions. Systems of exchange, rules of marriage, kinship terminologies, and political institutions were found to vary quite markedly within areas of relatively uniform biophysical conditions¹ (Milton 1997:478). Nevertheless, in the study of land-use strategies, there is little doubt that the biophysical environment within which households and firms operate influence the resource-use decisions that are made. The contention here, however, is not that the environment unilaterally determines resource-use. Rather, what takes place is an interaction, mediated

¹ The same argument cannot be generalized to other disciplines. Analyzing the long-term histories of civilizations from different continents, Jared Diamond argues that striking distinctions among human societies are primarily due to differences in their environments (Diamond 1999:405). Setting the analysis at the level of entire civilizations and at long temporal scales, Diamond emphasizes the role of four undisputable, objectively quantifiable sets of continental-level differences related to environmental aspects: a) wild plant and animal species available as starting materials for domestication; b) the existence of ecological and geographical barriers affecting rates of diffusion within continents for crops, livestock, and technological innovations; c) geographical or ecological isolation affecting rates of diffusion among continents; and d) continental differences in area and population size. Although not dismissing the role of culture, Diamond argues that some environments "provide more starting materials, and more favorable conditions for utilizing inventions, than do other environments." (Diamond 1999:406-408).

by processes that involve everyday actions performed by resource-users, the consolidation of practices, and subsequent allocation decisions. The result is an integrated system in which society and the environment continuously transform each other.

The interaction between the biophysical environment and land-use decisions is evidenced by a vast array of studies, including archeological and paleobotanical research. Some attest to the land clearing-motivated destruction of the resource base, such as in the ancient Fertile Crescent and eastern Mediterranean, leading to the ecological suicide of those societies (Runnels 1995, van Andel 1986; cited by Diamond 1999:411), and to the present-day constraints imposed on populations in those areas.² Other lines of investigation document contemporary land-manager responses, for example, to soil conditions in forested areas such as the Amazon (Moran 2002). The former examples illustrate cases in which biophysical conditions are susceptible to extreme change in ecologically fragile environments coupled with inappropriate land-use strategies (e.g., intense land clearing for agriculture, construction, and overgrazing). The once fertile woodlands were transformed into eroded scrub vegetation or even deserts. This is a scenario that policy interventions and legal mechanisms currently try to limit in still forested areas, such as the ones addressed by the second type of studies.

As with socioeconomic drivers, these biophysical features--in their more direct, material expression--also operate at hierarchical, interconnected scales. In addition to rainfall and soil fertility, proximate biophysical drivers include topography, proximity to rivers or other water sources, and microclimate, as well as the presence of pests and pathogens. The influence of intermediate-scale biophysical drivers has been documented

² For a more comprehensive discussion on the historical perspective of human-occupied ecological systems, see Headland's 1997 article in *Current Anthropology*, and respective comments.

through landscape ecology, a sub-discipline that emphasizes the interactions between spatial patterns and ecological processes. Regional landscapes appear to influence not only the choice of activities by individual resource-users, but also socioeconomic configurations at broader scales. Biodiversity and species composition in forested landscapes, and their predominant patterns of vegetation succession, should be of high significance for the definition of economic strategies by human populations in or around these landscapes. Even seemingly more distant (to land-managers) biophysical features exert their influence in resource allocation decisions, exemplified by the ENSO (El Nino Southern Oscillation) phenomena and global warming related trends.

Instead of being portrayed as detached, exogenous variables in the diagram, environmental features are showed on the same analytical plane as the one occupied by socioeconomic configurations (in Figures 1-2 and 2-1). In addition to sharing the same analytical level, socioeconomic configurations and biophysical landscapes equally receive a dual treatment in the framework. On the one hand, they correspond to the concrete operation and material outcomes of their respective constituent variables or driving forces. On the other hand, as I discuss in more detail when presenting the “interpretive” domain, socioeconomic and biophysical configurations (and their interactions) are the object of cultural interpretations and perceptions that contribute to their continuously dynamic state. Therefore, although avoiding deterministic statements like “environments shape cultures,” or more refined ones such as the notion from cultural ecology that “specific environmental factors shape particular cultural features” (Milton 1997:478), in the proposed framework I recognize that resource allocation decisions, and

socio-natural transformations in general, are affected by features of the biophysical environment and by specific forms through which humans interact with these features.

Relational Domain: Perspectives of Bounded Rationality

The two previous items show that, although acknowledging the constraining forces of structured socioeconomic configurations (to be addressed next), the framework conveys the idea that resource allocation decisions and land-use practices ultimately result from choices and actions made by individuals, households, and firms, the constituent members of these configurations. Therefore, while assuming that choices are bounded, or not entirely free, the approach suggests that there can be variation in the way individuals experience the constraining effect of social structures, thereby attenuating or accentuating the importance of structural conditions. The framework incorporates the notion of the duality of structures, through which structural arrangements are both the medium for and the outcome of practices they recursively organize, having neither deterministic effects on individual behaviors, nor an independence from organizational actors who experience its effects (Giddens 1984:25, quoted by Wicks 1998:373). While the interpretive domain of the framework considers resource-users' agency, and the mediation provided by perceptual processes of their past and current actions, the relational domain expands the rational perspective by acknowledging that resource allocation decisions are also based on individuals' constant assessment of their relative position within society. In this regard, the relational domain also draws on Durkheim's concept of social solidarity, and views naturally differentiated individuals and groups benefiting from their performance of complementary roles.

Indeed, a peril often present in approaches that apply rational-choice canons resides in the failure to recognize the distinct nature of benefits that individuals aim to

maximize. While profit- and utility-maximization are privileged by neoclassical economics, rational-choice explanations go beyond strict economic rationality, and encompass the choice of activities as based on particular assessments of needs, including orientations towards subsistence, leisure, personal convictions, and cultural survival. As asserted by Spickard (1998:106), "individual needs vary from time to time and place to place, and not all of the people in each particular time and place have the same spectrum of needs." Building on this broader perspective, the relational domain expands rational action by explicitly incorporating certain fundamental conditions of individuals within their respective socioeconomic configuration. On a case-by-case basis, these conditions contribute to the prioritization of needs and the choices made to supply these needs.

As noted, with this framework I assume that resource-users share to one degree or another particular combinations of social, economic, and political attributes, and embody specific demographic features. The diagrams in Figures 1-2 and 2-1 express this diversity via distinct fillings in the ovals that symbolize individuals A, B, and C. Such heterogeneity results in varied perceptions of structural constraints, in a diversity of needs or benefits to be maximized, and, eventually, in distinct underlying principles for resource allocation. These assumptions imply that a land-use practice that is rational to individual A, for example, may not necessarily apply to the needs and benefits of B.

Explanations based on this broadly defined "relational rationality," are part of this analytical framework. Resource-users are regarded as part of real-world scenarios, in which actors take into consideration socioeconomic and biophysical variables that contribute to or hamper their engagement in specific alternatives. Interactively bounded by, and constructing institutions and broader social structures, individuals determine how

to allocate resources at their disposal by engaging in a complex decision process that accounts for perceptions of their social, economic, and political conditions; and of their relative position within structures.

Structural Domain: Social Formations that Structurally Constraint Human Action

Previous sections of this discussion focused chiefly on the role of individuals as participants in interactively bounded processes of decision-making. Yet, individuals are part of socioeconomic configurations that operate according to fundamentally different principles with respect to human nature and social life. Therefore, this section turns attention to the role played by structured ensembles--or the effect of social structures--as a critical explanatory domain to understand resource-use decisions, land-use practices, and land-cover outcomes. According to this perspective, it is the power-based events and processes comprised by the operation of these structures that shape, maintain, and order human action towards socio-natural transformations.

I have presented the relational domain of the framework as accounting for social values, beliefs, and judgments that match functional needs of social systems and the reproduction of the social group. With the structural domain, I consider the production and power relations that are at work, and the reproduction of these relations among and within social groups. Informed by political economic approaches, the structural domain is largely influenced by views of a multilevel struggle for dominance and control among heterogeneous segments of society, marked by relations of production that individualize benefits, and produce continuous alienation and social differentiation. The structural domain also addresses transformations in the interrelations of socio-cultural and political-economic processes that surround and affect individual decisions.

Although the modes of production within social configurations can be unraveled in a series of anthropologically relevant traits, I have identified three features that are directly involved in the processes under investigation: the level of social stratification, the state of economic inequalities, and the distribution of political power. These traits represent a backbone of structured social forces. These forces are objective elements of decision contexts, which are also internalized by individuals, thereby contributing to shape their decisions and practices.

In the preface to his “Contribution to the Critique of Political Economy,” Marx (1904) supports the assumption that much can be understood about a social context by examining the relationships among society, economy, and politics. Acknowledging the powerful contributions offered by historical materialist approaches, I argue for the incorporation of Marxist perspectives in which human action is constantly embodied in the operation of broader social structures.

The dialectic interaction among individuals and the structures of which they are part is captured in the framework. The right-hand portion of the internal boxes in configurations α and β shows individual conditions. The left-hand side of those boxes (and their filling pattern) portrays aggregate social-structural conditions for those features. The interaction is represented by curved arrows connecting individuals A, B, and C; and the aggregated socioeconomic conditions of their ensemble. Changes in the color of text-boxes and background’s filling pattern indicate social structural changes from ensemble α (see Figure 2-1) to ensemble β , reproduced in Figure 2-2.

Similarly to the heterogeneity of individuals in a social configuration, there is also a continuous range in the degree through which distinctions among social configurations

can be examined. Each study employs certain temporal, spatial, and organizational scales, and these scales will delimit the depth and range of the analysis. Analyses of distinctions among tribal societies and chiefdoms, or among capitalist and socialist states, are quite distinct from assessments of differences among modes of production in configurations that include peasant producers, rural proletarians and capitalist farmers. In each case, dialectical relations among social segments determine patterns of behaviors and beliefs according to their specific historical, contextual moments.

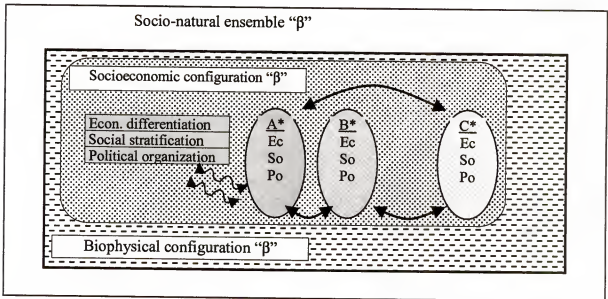


Figure 2-2. Dialectic interaction among individuals and social structures

The above statement properly emphasizes the historical perspective in analyses of structured social configurations. The framework expresses social phenomena as resulting from historical struggle. Figure 2-1 shows the critical role performed by history in the definition of social configurations and their interaction with nature. Headland argued that diachronic perspectives of human-occupied ecological systems are critical to understand their structure, functions, and the dialectic between environmental and cultural change (1997:607). The present study is in line with the contention that although "history does

not directly predict the future, ..., thinking historically involves understanding why actual choices were made, and the circumstances under which they could have been--and therefore might in the future be--made differently" (Ingerson 1997). History is not perceived here as a straitjacket for future undertakings. Rather, history is viewed as a necessary, but not sufficient source of information to explain present transformation. Moreover, in this framework I consider the presence of humans as fundamental to the application of what can be gained by assimilating and reflecting on what history informs. This is discussed next, as I present the interpretive domain of explanation.

Interpretive Domain: Transformative Practices Mediated by Ideology, Knowledge, Perceptions, and Discourse

By acknowledging the interplay of social structures and human agents, the framework address one of the main theoretical challenges confronted by social sciences in general: the fundamental dialectic condition of social life, through which society can be conceptualized as both the object and the subject of transformative practices. That said, further proceeding along the explanatory domains in this analytical construct is expressed through social practices that connect these two perspectives. Practice theory claims that reflexivity, intelligibility, and the practical understanding of things are articulated in practices, social phenomena being understood as a nexus of these practices, via the structures of and relations among them (Schatzki 1997:284). In the proposed framework, such a connection takes place by incorporating an instance of mediation. While investing people with the ability (or agency) to perceive and reflect on socioeconomic configurations, and even transform social structures, the approach allows enough flexibility to be altered by practices that emanate from these very social structures. This mediation is represented in the diagram (Figure 2-3) by a polygon in

which practices are informed by ideology, knowledge, perceptions, and discourse. The diagram symbolizes these conditions as mediating allocation processes and attitudes, which are unique and differentiated for each social group, and for every individual.

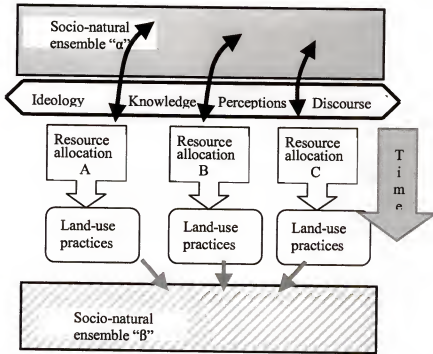


Figure 2-3. Schematic representation of the framework's interpretive domain

The formation of social practices and their role in decision processes is conceptualized here by expanding Bourdieu's practice theory (1977, 1998) to include what Giddens termed social reflexivity. These concepts are allied to contributions offered by interpretive and phenomenological³ perspectives of inquiry. According to Bourdieu, the objective conditions of a specific domain of practice generate dispositions (*habitus*) that will produce and select actions. The latter will eventually contribute to the reproduction of these practices and the conditions through which they were generated.

³ Phenomenology is the 20th-century philosophical movement founded by Edmund Husserl, sought to describe the structures of experience as they present themselves to consciousness, without recourse to theory, deduction, or assumptions from other disciplines.

Giddens' structuration theory (1984, 1995) includes the social reflexivity concept when referring to multiple sources of information and knowledge, and to the need to reflect upon the structural conditions of life to formulate and to follow procedures of action.

A critical notion to be incorporated here is the need to compare discourse and practice. While structuration and practice theories recognize that individuals commonly reproduce the main principles of society by drawing on similar rules and resources, such recognition can be expressed through discursive and practical forms of consciousness. Language and discourse are viewed as constitutive of reality and are introduced in the socio-natural order through the production of discourse. The latter are "manifestly constitutive of reality (or, rather, of a multiplicity of realities), defining various forms of agency, administering certain silences, and prescribing diverse forms of intervention" (Brosius 1999:278). Discursive consciousness refers to "everything actors are able to . . . give verbal expression to, about social conditions, including especially the conditions of their own action." Practical consciousness refers to what actors understand and know about these conditions but do not express verbally (Giddens 1984:374-75).

Giddens also sees human action as mediated by reasons and wants (1984:376), therefore providing common ground with interpretive perspectives. The latter recognize multiple interpretations of the world, and multiple dimensions of knowledge, none with superiority over the rest. Contributions offered by interpretive approaches are based on idiographic analyses emphasizing the meaning of complex relationships generated and expressed by those involved in the observed contexts. This perspective asserts that research questions may not necessarily be addressed solely by empirical data, but rather gain from the interpretation of reality from the point of view of the members of a society.

Interpretive approaches access human thought and action in terms of their meanings for the actors (McIntosh 1997:328), considering what is experienced as interpretive and perspective-based in character. Phenomenological approaches, on the other hand, assert that analysts should suspend (but not abandon) their own judgment about the status of what is being analyzed, and examine interpretations as intentional processes of construction. Although most phenomenologists neglect the empirical world and leave behind all questions of fact, McIntosh (1997:338-9) has shown that modes of inquiry can integrate phenomenological and empirical investigations through the alternation and complementation of research protocols. In other words, employing interpretive/phenomenological stances does not preclude the analyst from sticking to his or her frame of reference for the empirical understanding of processes and decisions made in a world as he or she conceives. As McIntosh states, “one must of course be as reflective as possible about this frame of reference, and the phenomenological method can be of great assistance” (1997:339).

Having presented the explanatory domains that form the analytical framework of this study, in the remainder of this chapter I discuss three critical concepts for the analysis. I then incorporate these concepts into the theoretical construct, and spell out a “grounded political ecology” approach to understand socio-natural transformations.

Conceptualizing Rural People in Lago do Junco: Socioeconomic Stratification and Land-Use Dynamics

Subjects of this Study: Rural People in Lago do Junco

Rural people in Lago do Junco (and in the entire Mearim Valley) are named through the use of multiple terms according to the focal construction and context, and coherently with narrative, descriptive, or analytical dimensions of specific passages. This

reflects the attempt to integrate anthropological sub-disciplines and methodological traditions within distinct levels of abstraction (namely ethnographic and applied research, and their interaction with theoretical formulations). Yet, although emphasizing the multidimensionality of individuals' social lives, the superposition of designations only partially grasps the complexity of real-life situations.

Three perspectives can be identified to designate the subjects of this study. The first set of expressions are the representational categories applied to situational, practical contexts that are used both by subjects and analysts. They include official categories used by bureaucrats, policy-makers, and partially by social scientists. The second set includes terminology used by the subjects to distinguish themselves from outsiders, including designations defying those conventional categories. Finally, the third set contains anthropological concepts employed by analysts according to theoretical elaborations of "social types," or as stated by Little with respect to Weber's ideal types (Weber 1949:90), they are "complex, structured representations of social categories that emphasize certain features and abstract from others" (Little 1989:194).

Representational and identification categories

Whereas representational and identification categories suggest a degree of semantic complexity, I summarize the complexity, which is discussed in detail in Appendix B, in Table 2-1. With terms that are employed in daily conversations among residents in the communities, or within the policy, legal, and administrative domains, Table 2-1 shows the diversity of categories through which rural types are actually perceived in the study sites.

Table 2-1. Categories used to represent and identify rural people in the Mearim Valley

Analytical categorization	Mainly used by	Rationale for use	Criteria	Examples
Representational (situational)	Subjects and analysts	Specific contexts of their historical moment	Land tenure arrangements	squatter (posseiro) renter (arrendatário) sharecropper (parceiro) landowner (proprietário): small, medium colonist (colono)
			Condition according to state programs	settler (assentado) occupant (ocupante) landless (sem-terra)
			Occupational	manager (gerente), manual worker (peão) agro-extractive (agro-extrativista) shifting-cultivator
Identificational	Subjects	Distinguish themselves from outsiders	Production of agricultural crops	producer (produtor); small-producer rural producer (produtor rural) cultivator (lavrador, roceiro) horticulturist* (agricultor)
			Other occupational	riverine fishermen (ribeirinho) gold-miner (garimpeiro) quebradeira de côco babaçu cattle hustler (vaqueiro)
			Class connotation	rural worker (trabalhador rural) rancher (fazendeiro)
			Contrast with urban environments	people from the interior (povo do interior) people from community (da comunidade) people from the mutirão (do mutirão)

Conceptual categories

A third, distinct set of terminologies includes theoretical elaborations. I devote more attention and clarify ontological commitments⁴ involved in the use of these conceptual categories. I argue that one has to avoid reifications by attributing features to theoretical concepts that go beyond their intrinsic attributes. Although recognizing the relevance of these conceptualizations for analytical purposes, one has to be aware of the distinctions between representation and reality, and therefore contextualize as much as possible the theoretical definitions, in time, space, and social-structural characteristics.⁵

⁴ Ontological commitment is an agreement to make assertions consistently with the theory specified by an ontology--the description of concepts and relationships for an agent or a group of agents (Gruber 1993).

⁵ Kearney (1996:42-70) discusses the role of Anthropology in constructing and containing representations of rural types as part of the architecture of the nation-states with which they have been identified.

Two distinct levels of abstraction are used in this study to define these conceptual categories. The first one is an inclusive analytical category with a lower level of theoretical strength, capable of designating all agents of land- and resource-use in Lago do Junco, regardless of internal distinctions. Most terms of Table 2-1 are limited in that respect. The reason to exclude other terminology is more subtle. Producers, and units of production, for example, are both limited by a productionist notion of generating economically recognizable outcomes. Landholder is a term limited to the idea of attachment to a piece of land, a condition not always characterizing shifting-cultivators.

“Resource-user” is a concept broad enough to designate all those subjects at once, as it lacks situational, political, or ideological cuts. It covers a broad range of biophysical resources, and is not, therefore, limited to land. Yet, to be consistent with related policy and theoretical discussions, “resource-user” is used interchangeably with “land-user.” This usage assumes that “land” refers to the aggregate biophysical resources available to these people. The terms are used in a generalized manner, encompassing the continuous range of people in rural Lago do Junco, and dismissing further theoretical elaboration.

Resource-user and land-user, however, are too general to delimit the social types of this study. It is appropriate to address the opposition that exists in social formations such as rural Lago do Junco: the upper social strata (market-oriented ranchers), and the majority of other resource-users. Determining if such a dichotomy reveals perennial differentiation, or contextual differences in economic strategies, is a key question of this study. Although I do not deny that further distinctions exist within “subsistence-oriented” resource-users, to recognize such a strong dichotomy suggests employing a common designation for them. I believe that “peasant” is still the more adequate concept.

Before justifying my choice, I explain the reasons for rejecting alternative representations. Contemporary rural people in Lago do Junco are partially ethnic descendants of Amerindian groups that inhabited Maranhão and other northeastern states. However, they don't identify themselves with those cultures, nor as indigenous peoples.⁶ African and Portuguese ethnic components are stronger in their socio-cultural identity, the latter through long-term miscegenation. Indeed, as the mestizos discussed by Wolf, peasants in Lago do Junco are for the most part "ambiguous individuals not conforming to conventional racial and social identities."⁷ (1959:242)

Even though people rely on family labor and on tools such as axes, sickles, large knives, and pointed sticks for cultivation, I also avoided productionist criteria, and have not used the category horticulturalists. There is more at stake in this conceptualization than the economic operation of the household, and horticulturalists are often associated with tribal and chiefdom social systems, what is clearly not the case in Lago do Junco. Yet, by adding the expression "agro-extractive/shifting-cultivator" to the peasant concept, I call attention to the distinctiveness of their survival strategies to characterize their social type. Hence, the "subsidy" provided by nature (Anderson et al. 1991) in the form of high biomass babassu-based secondary succession is one of those exceptional circumstances through which a swidden system is capable of supporting a peasantry (Wolf 1966:20).

Finally, I avoided referring to Lago do Junco's producers as smallholders to be consistent with attributes frequently associated with the latter term. Departing from the

⁶ Indigenous peoples are defined as "the living descendants of those who inhabited a geographical region at the time when people of different cultures or ethnic origins arrived, the new arrivals later becoming dominant through conquest, occupation, settlement or other means" (United Nations 2001).

⁷ This should not be generalized for the Mearim Valley, as attested by "black communities" in São Luis Gonzaga, Bacabal, and Pedreiras; and by Tenetehara indigenous populations near Barra do Corda.

concept of peasant, Netting (1993) argued for a specific treatment to be given to smallholders through explanations derived from cultural ecology (Steward 1955) and influenced by agricultural intensification theory (Boserup 1965). Although resource-users examined in this study share some features with those conceptualized by Netting, they differ in the basic traits of that definition. Netting excluded from his definition “shifting cultivators practicing long-fallow or slash-and-burn farming where land is still plentiful and population density is low” (1993:2). Although land in Lago do Junco became a scarce good for most of the population, such scarcity is rather a consequence of land concentration than the result of population growth itself.⁸ Even with land scarcity, local production per unit area remains relatively low and increasingly unsustainable.

I do not elaborate a comprehensive debate on the suitability or not of “peasant” as a contemporary analytical category. However, a few remarks are appropriate to justify that such representation will not harm the internally differentiated socio-cultural identities in the study area. Indeed, rural people can be represented in this study as peasants in the general sense that, as asserted by classical definitions, they live in a state, complex society, participate in economies based on exchange relations mediated by markets, and maintain asymmetrical relationships of unequal access to wealth and power. Households are the entities providing for survival, assuming the roles of production and consumption units, continuously employing and balancing strategies to meet external demands for increased production against their needs (Stavenhagen 1978:31; Wolf 1966:10-17).

However, these peasants no longer correspond to the undifferentiated traditional order (Roseberry 1989:56) that reveals the strength and cultural integrity of the

⁸ Kearney (1996:102) sees the effect of land concentration as an example of “relative population increase.”

self-sufficient closed corporate little community (Redfield 1956). They are not individual cultivators isolated in their subsistence needs and interacting among themselves and with other non-cultivator/non peasant households. Neither are they part of a society restricted to idealized households that a-historically differentiate themselves demographically with the rationale of maximizing the reproduction of the domestic unit (Chayanov 1976). In opposition to such views, my choice of peasant as an analytical category derives from observing in Lago do Junco individuals and communities broadening their socioeconomic relationships and cultural identities. I argue that deconstructing the structures that informed the images of the modern peasant does not necessarily require us to condemn the concept itself. Instead, I believe that, in particular historical moments, intellectual representations of contemporary rural peoples as peasants would rather empower than harm the social and power relations experienced by these people.

Peasants in Lago do Junco assumed the primary historical role of collectively engaging in their own, localized liberation movement. They are internally differentiated subjects, whose differences occur in distinct domains and appear in different moments, the differences themselves being critical components for the reproduction of the category. The attachment to land and other local resources, allied to what was presented justifies the designation of this broad array of ethnographic diversity as a peasant society, even though it may not include the archetypical peasant producer. I highlight the existence of this peasantry in a sense that they form a society of individuals performing a variety of functions within multiple spatial and temporal realms, differentiating themselves according to flexible intensities and mechanisms. In the present historical moment, this society finds a solid ground for resistance and social reproduction, and should not be

disembodied into distinct theoretical sub-categories. There is no need for doing so, as by virtue of their own nature, these individuals dynamically rearrange themselves through combinations of social-structural, cultural, and economic orientations. There is no better representation for them as a heterogeneous, ambiguous and dynamic social group than this revised concept of peasant, considered not as an absolute category, but as an inclusive one that can be molded by the analyst according to specific situations.

The concept of peasant is one of the main targets of the modernization discourse. Scientific approaches that follow such tradition assess peasants as technologically backward, resistant to innovation, inefficient, old-fashioned, a barrier to modernization. In sum, they are viewed as a category peripheral to the capitalist system. By employing the concept of peasant as an analytical category in this study, I create an interface among anthropological representation and applied agendas such as the land-use/cover change one. With this, I challenge epistemological and scientific lines of inquiry that assume bounded categories that simplify or reduce what is in fact a complex entity formed by individuals with inherent ambiguities and increasingly complex identities (Kearney 1996:40). This choice attempts to break with academic predispositions and makes a clear effort to carry on and affirm the role of representations in circumscribed intellectual circuits. Therefore, instead of restrictively prioritizing empirical observation of functional attributions of these legitimate land-users, I integrate and devote careful attention to less present (in land-use/cover research protocols) socio-cultural domains of their existence.

As Wolf once stated, retaining the capacity to access land and other resources will always be critical for peasant autonomy and survival without undue commitments to a social order that threatens their maintenance and reproduction (Wolf 1966:17). The case

of Lago do Junco illustrates the extent to which this occurred through strategies ranging from developing leveling mechanisms for sharing resources within the community, to the proliferation of social identities that apparently contrast with the classic definition of peasants, to letting selective pressures differentiate the better-off from the more vulnerable members of the group. As the body of this work demonstrates, this has profound implications for the natural environment.

Inequality, Economic Differentiation, and Social Stratification

A few decades ago, anthropologists concerned with the origins of cultural phenomena sought to identify the stages through which social stratification and inequalities evolved in society.⁹ In the last two decades, cultural anthropologists have shifted orientation and focus from structural approaches to perspectives prioritizing individual agency, decision-making, and indigenous standpoints. Yet, stratification remains a critical aspect in the understanding of social relations, and is an issue of major concern to the discipline.

Social stratification in general terms is defined as the existence of unequal rights and privileges for individuals, groups, and, ultimately, classes that occupy hierarchically different positions in society. In Marxian theory, social stratification is explained exclusively in the work place. The distribution of resources, wealth, power, prestige, and

⁹ Service (1962) presented the classic scheme of cultural development that approaches societies as evolving from bands to tribes, chiefdoms, and states. In his early writings, Sahlins (1961) argued for further distinctions in cultural evolution among tribal societies that, motivated by ecological factors, developed a segmentary lineage system. Departing from explanations of stratification phenomena through personal skills and individual differences, Fried (1967) proposed another model in which undifferentiated societies evolved to increasingly complex and specialized forms through stages of development he characterized as egalitarian, ranked, stratified, and state societies. Giving precedence to explanations based on material economic features, demographic changes, and conditions of the environment, these neo-evolutionary models of social organization argued for, as once stated by Sahlins (1961:324), "culture's movement toward complexity, the general, progressive aspect of evolution." As proposed by these models, complex stages of development featured higher levels of differentiation, or increased social stratification.

ideologies is regarded as having its roots in the relationship of the differing social classes to the means of production and distribution.¹⁰

Social stratification in society--even when approached according to the Marxist perspective only--can be expressed through a wide array of attributes. Despite the overlapping nature of the political, economic, and socio-cultural domains of human societies, important distinctions should be noted among conceptualizations of social stratification when the emphasis is on political organization (stratification/inequalities in political power), class formation (structural inequalities according to Marxian notions of class struggle), economic differentiation (stratification/inequalities in economic strategies and economic returns), or status/honor differentials (stratification/inequalities based on age, gender, religion, or race/ethnicity).

Processes of status attainment or social mobility whereby some individuals or groups are able to obtain more strategic resources than others are associated with the concept of stratification. Social groups formerly considered egalitarian progressively felt the effect of stratification, the phenomenon no longer being viewed as a unique characteristic of present-day, complex societies. In addition, better distinctions among levels and dimensions of the term are required because the political, economic, and cultural processes related to stratification are subject to large variations in scale and order of magnitude. The nature of and the distinctions among these dimensions are of concern

¹⁰ Distinguishing between social class and social stratification, Stavenhagen (1966) employs the Marxist framework to note that while the first concept pertains to the base of a society's forces and relations of production, the latter is heavily influenced by this society's values and ideologies, and should therefore be approached as a superstructural component. Stavenhagen argues that stratification schemes tend to conservatively function on behalf of a society's superior strata. By colliding with the dynamic nature of social relations, he claims that such schemes may turn into obsolete images of the class relations from which they were originally derived, and attenuate the oppositions among those classes (1966:164-168). For a perspective of social stratification that departs from the polarity between the material and the symbolic and incorporates gender and ethnicity, see Anthyias 2001.

not only in anthropology. As stated by Blau (1977), "the most distinctive task of sociology is the structural analysis of various forms of differentiation (such as heterogeneity and inequality), their interrelations, the conditions producing them and changes in them, and their implications for social relations." The main contribution to be offered by cultural anthropology is thus the examination of such interrelations under situated contexts and cross-cultural perspectives.

Despite the theoretical character acquired by analyses of stratification, its applied importance is evident when these formulations are transposed to concrete cases of current events in societies with increased inequality. Tribal and indigenous peoples around the world experienced transformed levels of social complexity due to greater interaction with the broader society, the state, market institutions, and the effects of the global economy. Cultures formerly considered as egalitarian began to experience change that at times remained in the domain of relatively simpler (although pronounced) cases of economic differentiation, while others suffered more complex ones involving class formation.

The rationale for differentiating individuals and groups in societies that are internally stratified according to (mainly) economic criteria, with relatively little class differentiation, is their disposition according to the distribution of a quantitative parameter. In social systems in which processes of differentiation reach beyond the economic sphere, the rationale includes interconnected analytical categories. Therefore, in-depth analyses of how social stratification operates within social systems are likely to raise understandings of their cultural, economic, and political dimensions, and improve assessments on the impact of current events on human relations. Comparative studies of this nature will thus link economic anthropology to applied fields of development work.

This research aims to verify the extent to which (and the mechanisms through which) economic differentiation sets the stage for, or else is a consequence of more enduring sociopolitical inequalities that lead to class formation. This approach addresses the extent to which changes in social relations are influenced by transformations in the relative status of individuals and groups in society, to the point that they will or will not constitute distinct classes. In this investigation, the extent to which such transformations correspond to class formation is established through objective indicators and historical data, corroborated by cultural constructions expressed through narratives.

Communities that struggled for land in Maranhão illustrate the dynamic nature of the dimensions of social stratification. Stratification within polarized social systems is more inclusive, encompassing at once the attributes and parameters of the economic, political, ideological, and cultural dimensions. Conversely, social systems considered more “developed” tend to show multiple (or parallel) hierarchies in which individuals and groups are arranged in different manners according to the specific dimension being prioritized. Opposed to the unidimensionality of the former, social stratification assumes multiple characters in the latter. This change is historically manifested in Lago do Junco: until the mid 1980s, access to resources was a function of political, economic, cultural, and ideological dimensions that jointly discriminated between peasants and ranchers. In the last decade, however, each of the dimensions features a particular hierarchical order.

Ethnographic research presented in this study is a proper venue to assess the detailed manifestation of processes and attributes of social stratification and the emergence of inequalities within specific cultural groups. This kind of research adds to historical and archaeological analyses that have diachronically and comparatively

approached the operation of hierarchical stratification at the level of larger social groups, even entire civilizations. In the economic anthropology of contemporary rural peoples, however, the study of stratification and inequalities has been overly focused on particular sets of investigations. An extensive body of literature comprises investigations of stratification among stateless societies such as nomadic hunter-gatherers or pastoralists.¹¹ The appraisal that more directly relates with the present study, however, focuses on economic differentiation and social stratification in the context of peasant studies.

Social stratification and economic differentiation within peasantries

While most pastoral societies have been experiencing processes of stratification, differentiation, and inequalities for a very long time (even though political economic factors have been much more intense in the last half century), the time horizons through which peasants--and certainly those in the Americas--have been experiencing these processes are much shorter. Therefore, an initial remark on research on the study of social stratification among peasants, and particularly those recently installed in frontier and peripheral areas, refers to the need to understand the baseline conditions in particular locations prior to their existence as social groups. At times the strategy even requires the assessment of historical processes of exclusion at other sites.

¹¹ Pastoralism is the system of production where human populations live on the products of their domestic animals in arid environments or areas of scarce resources (Fratkin 1997:235). Scholars of pastoral societies tended to agree on the existence of a continuum between largely egalitarian and highly differentiated, hierarchical societies. However, lower consensus exists on whether the debate should be centered on the political organization (Barth 1961; Lewis 1961; Salzman 1982, 1999; Schneider 1979) or on the economic sphere of stratification/inequality (Fratkin 1994; Grandin 1988; Herrens 1991; Sieff 1997; Sutter 1987). Other perspectives include political-economic/political-ecological research (Aronson 1980; Baxter and Hogg 1990; Behnke 1980; Little 1985; Rigby 1992), while a distinct set of studies corresponds to sociobiological formulations (Borgerhoff-Mulder 1991; Casimir and Rao 1995; Irons 1979; Turke 1985). Finally, other studies approach status differentials within pastoral peoples from the standpoint of gender relations (Kelly 1992; Young 1996) or age-set systems (Dyson-Hudson 1966; Spear and Waller 1993).

When research on peasant studies first took off,¹² Marshall Sahlins argued that primitive and peasant economies, in which kinship relations play a major role, operate below their economic potential, are “under productive” (1972:39-41). Inefficiencies will remain among the most capable for these communities to achieve a level of development within the reach of the majority. As a consequence, a considerable portion of the labor force will be underused (1972:89-91). The “moral economy” approach argues for a peasant subsistence ethic marked by risk avoidance behavior that limits competition over scarce resources. According to this ethic (which resembles notions of egalitarianism in studies of pastoralist societies¹³), instead of economic rationality, social institutions such as community networks, instances for labor exchange, and leveling mechanisms, have priority in the definition of resource allocations that sustain their well-being.

In his explanation for peasant resource allocations that adversely influence economic growth, George Foster claims that as far as the peasant is concerned, “all of the desired things in life ... exist in finite quantity and are in short supply” (1967:304). Foster contends that the image of limited good is a dominant cognitive orientation¹⁴ in peasant

¹² The core of the literature in peasant economics informs opposing perspectives addressing social stratification/economic differentiation. The first is referred as the peasantist (“campesinista”) perspective, influenced by the “moral economy” approach. The second is the proletarianist (“descampesinista”), or the political economy perspective. Deconstructing this opposition a step further, Kearney (1996) points to two major dimensions of the “intellectual warfare” regarding the debate on peasant economy. One dimension contrasts proletarianists and peasantists schools of thought, while the other opposes modernization theorists and romantic populists (Redfield, Chayanov, and James Scott). Kearney (1996:108-109) asserts that higher stakes exist when both dimensions are present, and exemplifies with the debate among classical Marxists (proletarianists/modernists) and Chayanovians (peasantists/romantic populists).

¹³ “Ethos of egalitarianism” is defined as a value system that operates against stratification and informs “any intentional behavior that suppresses hierarchical relations among adults as political actors” (Boehm 1993:228). Egalitarian behavior among pastoralists is manifested, for example, by acts of sharing milk and the existence of animal exchange networks, mainly through marriage (Almagor 1978; Fratkin et al. 1999).

¹⁴ Foster (1967:300) defines cognitive orientation as the “unverbalized, implicit expression of a society’s understandings of the ‘rules of the games’ of living, imposed upon them by their social, natural, and supernatural universes.”

societies, coherent with the notion that “apparent relative improvement in someone’s position with respect to any good is viewed as a threat to the entire community” (Foster 1967:305). Such orientation discourages changes in the status quo of social relationships and promotes practices that are crucial for the maintenance of the peasant social system, maximizing security and preservation of the traditional order of things.

The most preminent expression of the moral economy approach is the work of James Scott (1976) and his debate with Samuel Popkin (1979). The debate confronts Scott’s social security mechanisms and harmony within communities, with Popkin’s emphasis on the sources of conflict among rational peasants guided by self-interest. Whereas Popkin stresses peasants’ individual calculations to raise their standard of living, Scott portrays peasant rationality as guided by a central preoccupation to feed their households reliably, despite the minimal marginal return of the extended labor allocated. Guided by such concerns, peasant cultivators, rather than maximize their average return, would prefer to minimize the probability of a disaster through risk avoidance practices that exclude economic returns that could eventually fall below a subsistence danger level.

Chayanov’s theory of peasant economy views the peasant farm as “a family labor farm in which the family ... receives a single labor income and weights its efforts against the material results obtained” (1976:41). Self-exploitation of the peasant labor force,¹⁵ and demographic differentiation,¹⁶ are basic concepts in his theory. Given socially accepted minimum standards of living, Chayanov posits that a natural equilibrium in the

¹⁵ Labor intensity is determined by internal and external factors. Internal factors are family consumption demands. The external ones are production conditions determining productivity (Chayanov 1976:76).

¹⁶ “Every family, depending on its age, is in its different phases of development a completely distinct labor machine, as regards labor force, intensity of demand, consumer-worker ratio, and the possibilities of applying the principles of complex cooperation” (Chayanov 1976:60)

allocation of resources occurs when the drudgery of marginal labor expenditures is equal to the subjective evaluation of labor's marginal utility.

Critiques of the theory allude to the interference of social networks within households, and among them and other social agents. Heynig (1982:129) points out that Chayanov ignored social differentiation, and considered peasant family farms as independent from larger social formations. Deere (1987:7) notes the absence of both the internal and external relations of the family-labor enterprise, while Kearney (1996:147-49) argued that Chayanov had little concern for peasants as social and cultural beings, which limited his analysis only to production and consumption. The unified notion of peasant households is contested by evidence of age and gender differentiation (Harrison 1976:329-334, 1979:89), which do not conform to aggregations of family members under unified rationality and consciousness.

Incorporating the moral economy approach and characteristics of peasant units of production, "campesinistas" have argued for the survival and strengthening of peasant production instead of their complete transformation into proletarians, despite the expansion of capitalist class relations. Other peasantist explanations for their persistence include functionality to capitalism, and the inability of peripheral capitalism to absorb the peasant-transformed-into-proletarian labor force (Deere 1987:43, quoting: Diaz Polanco 1977:36; Lehmann 1982:158; Stavenhagen 1978:34-35; Warman 1980). Indeed, peasantist scholars sustain that the subsistence of the peasant economy in underdeveloped countries is a condition for capitalist expansion (Stavenhagen 1978).

The political economy approach to peasant studies, on the other hand, sees the growing differentiation of a heterogeneous society, and places emphasis on historical

analyses of regional processes of development of the forces of production. Political economists explore issues of articulation and integration, situating the peasantry within broader regional, national, and/or international frameworks (Brettell 1999:2-3).¹⁷

These analyses are therefore centered on class processes,¹⁸ defined as the relations and processes of production, appropriation, and distribution of surplus labor¹⁹ (Deere 1987:14-16; Resnick and Wolff 1982:2). As reviewed by Deere and de Janvry (1979), inequality in the access and distribution of means of production is considered the basic condition leading to differentiation. According to these perspectives, households that control their means of production and the labor process will retain at least part of their labor surplus and will either elevate their consumption levels or accumulate additional means of production, potentially experiencing social differentiation. Conversely, households that have their conditions for economic accumulation and social reproduction limited by capital are greatly exploited in their surplus labor, and are gradually forced to cope with indebtedness, proletarianization, and migration.

Departing from the opposition between these two extreme approaches, other frameworks have been developed for peasant economic differentiation and/or class

¹⁷ Such propositions regarding peasant social differentiation were initially based on classic Marxist, and particularly on Leninist analyses of European conditions, and viewed the process as pushed by growing penetration of capitalism, inevitably transforming peasants into either rural proletarians or rural bourgeoisie, the latter eventually turning into capitalists. For Lenin (1956), capitalist development in the rural sector leads to "depeasantization" through a process of accumulation based on wage labor and the elimination of the individual smallholding.

¹⁸ Class processes are defined as either fundamental (the production and appropriation of surplus labor) or subsumed (the distribution of surplus labor) (Resnick and Wolff 1982:3). According to the authors, subsumed classes (such as merchants, money-lenders, and landlords) neither perform nor produce surplus labor. They maintain themselves by means of appropriating shares of surplus labor produced by others.

¹⁹ In Marxian epistemology, surplus labor is a level of production greater than what is required to reproduce the resources (means of production) used up in the production process, and the historically defined level of subsistence consumption. The appropriation of surplus labor is one possible form to extract surplus value.

formation. Considering the articulation of non-capitalist modes of production within capitalist social formations, these frameworks contend that peasants experience dynamic processes of transformation, yet their economy will persist. Such analyses view social differentiation as influenced not only by the productive capacity of the units of production (Llambi 1989; Schejtman 1980:294), but also conditioned by different levels of household reproduction according to their participation in multiple class and non-class processes²⁰ (Deere 1990). It is the interplay of economic, political and cultural factors that then sets the stage for peasant differentiation.

Kearney advocates a "dismantling of spatial and temporal binary oppositions in the present historical moment, characterized as transnational, post-developmental, and global" (1996:43) and emphasizes the "dissolution of much of the oppositions between rural and urban, developed and underdeveloped, and between peasant and non-peasant" (1996:120). Addressing social identities affected by internal differentiation resulting from migration, the penetration of agro-industry, and the dominance of capitalist agriculture, Kearney describes peasants as polybians, "creatures moving in and out of multiple niches, ... adapting to different modes of existence opportunistically occupying different life spaces" (1996:141), and part of a dynamic process of transformation of values and power. Whether the focus on internal differentiation of peasantries is sustained, as opposed to approaches based on productionist criteria, is an issue that depends on specific historical and political-economical situations. In this regard, predominant economic strategies, and the way in which resources are used, play an important role. A closer examination of the concept of land- (and resource-) use dynamics is thus appropriate.

²⁰ Non-class processes include household relations; the economic, cultural, and political practices ruling the formation of households and the interaction between units of production and reproduction (Deere 1990:14).

The Concept of Land-Use in Cultural Anthropology and Across Disciplines

“Land-use” is a concept widely used across disciplines. It is central to studies in both the social and natural sciences. Land-use involves the manner in which biophysical attributes of the land are handled, and the cultural components defining the manipulation. The related concept of “land-cover” refers to the biophysical state of the earth’s surface and immediate subsurface. Landscape is conceptualized as the perspective and “material manifestation of the relation among humans and the environment” (Crumley 1994:6).

Human classification systems, regardless of formulations by scientists or resource-users, identify types (or classes) of land-use and land-cover. In practice, most scientific protocols tend to reduce the array of land-use types to limited sets of discrete categories. In the real world, however, land-use corresponds to combinations of multiple activities, as land-cover often reflects continuous stages along transitional paths. The choice between adopting discrete, well-defined categories, or a continuous, more flexible system of classification expresses the degree of cultural relativism, and the subjective interpretation imposed by analysts.

Indeed, the concept of land-use assumes various nuances, which conform to disciplinary and paradigmatic orientations. Some studies focus on concrete changes in human activities resulting from transformations in the environment. Others emphasize political processes and the social context that motivate such transformations. Still others strictly emphasize cultural interpretations and representations of these processes. To acknowledge the diversity of theoretical contributions to the study of land-use dynamics requires recognizing the multiple perspectives that can be invoked, thereby reinforcing the claim for an integrative approach. This section reviews the diverse conceptualizations of land-use within anthropology, and across disciplines.

Land-use studies in anthropological research

The study of land-use has always been important in anthropological investigations, since the use of land is fundamental to human culture and subsistence. The subject is central to the agenda of ecological/environmental anthropologists, and for economic anthropologists as well. Causes and implications of land-use change have also been approached in archaeological research, and by anthropologists working in applied projects or programs, either in the development or conservation traditions, as well as those documenting and advocating indigenous land-rights and claims. To some extent, the range of paradigms and perspectives employed to study land-use mirrors the diversity of anthropological approaches to human/environment interactions (see comprehensive reviews by Headland 1997; Little 1999; Milton 1997; Orlove 1980).

The study of land-use was part of early anthropological investigations on the African, Australasian, and Native American cultures that relied on natural resources for subsistence and reproduction. Historical particularists gathered ethnographic data to elucidate the role of the environment, psychological factors, and historical connections that produce cultural customs, traits and lifestyles of a society (McGee and Warms 1996:128). Their methodological protocols led to important insights for understanding, for instance, Native Americans' resource-use (Boas 1925; Kroeber 1939; Radin 1926).

Functionalists approached land- and resource-use as cultural institutions that maintained the stability and cohesion of society, while meeting basic individual needs. Malinowski analyzed how cultural beliefs and practices (including resource-use) of the Trobriand islanders (1922) fulfilled needs for nutrition, reproduction, bodily comforts, safety, relaxation, movement, and growth; while maintaining the smooth functioning of their society. Evans-Pritchard emphasized kinship structures that influenced resource-use

and distribution among the Nuer (1940). Yet, their ethnographies treated land- and resource-use as passive backgrounds for the operation of culture, with little elaboration of the role played by ecological factors within dynamic cultural contexts.

Features of the environment and technology gained further expression within anthropological inquiries in the mid 20th century. Theories and paradigms offered by cultural ecology (Steward 1955), cultural materialism (Harris 1968) and ecological anthropology (Rappaport 1968), all shared the assumption that broader structures, or systems, constrained human activity. According to Steward, a “cultural core” of features responded primarily to environmental circumstances. Patterns of a society’s land- and resource-use followed environmental adaptations as part of a process of multilineal evolution. Cultural materialism, a neofunctionalist approach, explains resource-use as cultural adaptations that incorporate rational principles imposed by predominant modes of production. Ecological anthropology focused on the material consequences of human activity, with assumptions borrowed from scientific ecology. As conceived by Rappaport, ecological anthropology interactively assesses land- and resource-use through the insertion of the ecosystem concept, in which ecological relationships among populations and their environments are regulated by material exchanges and feedback mechanisms. These three research traditions (cultural ecology, cultural materialism, and ecological anthropology) set the foundations for contemporary studies of human/environment interaction. Yet, as argued by Milton (1997:481), people’s agency in their everyday actions for resource allocation was not yet, itself, a critical object of inquiry.

In the 1960s, another anthropological tradition--ethnoscience, and more specifically, ethnoecology--began to focus on the specific objectives of human activities.

Instead of privileging the material effects of such activities, attention turned to the knowledge needed for particular forms of resource-use. Pioneered by Conklin (1957), ethnoecology focuses on perceptions and manipulations of the environment, and includes the study of local land-use systems according to cultural traditions. Ethnoecologists examine ecological interactions denoting situated knowledge, values, and belief systems, and employ linguistic analyses on how people recognize, classify, name, and perceive nature in each local context. The approach emphasizes cognition in shaping action, or the interfaces among ways that people see elements and relationships in the environment, and ways they decide and act on that environment (Nazarea 1999). Recent ethnoecological research has incorporated political and economic dimensions influencing the ways people interact with nature, and use the land (Alcorn 1984; Balee 1989, 1994; Posey 1985).

A paradigm shift also occurred in archaeology, as researchers studying thresholds at which cultures change developed protocols with insights gained from the study of contemporary societies (Binford 2001). The ethnoarchaeological paradigm contends that major patterns in human behavior are traceable in the archaeological record. Accordingly, such features as population density, economic subsistence, and social organization of prehistoric groups can be explained based on the understanding of their environmental and demographic circumstances, of which land-use is central.²¹

In the last 25 years, concepts and methodologies draw from cultural ecology, cultural materialism, ecological anthropology, and ethnoecology inspired anthropologists to document the contributions of specific land-use activities to the livelihood, social relations, and identity formation of societies facing diverse cultural and ecological

²¹ For instance, contemporary land-use attributes were used to identify patterns and processes that affected prehistoric hunter-gatherer (Brody 2000) and ancient pastoralist societies (Kuznar 1995).

configurations around the world. Anthropological approaches to human/environment interaction that emerged in this period, and are applied to the study of land-use dynamics, correspond to four major categories: the ecological, political, applied, and interpretive research approaches in the study of land-use dynamics. These categories, which overlap with several of the underlying principles of the domains of explanation in the framework used in this study, are discussed next.

The "ecological" research approach focuses on ecological features directly related to material aspects of land-use change. The approach is used by anthropologists who study patterns and processes of land-use change per se, and who adopt scientific protocols for the analysis of human/environment interactions according to actor-based, decision-making models. Characterized by a wealth of biophysical data integrated with ethnographic and ethnoecological case studies, this approach was informed by theoretical and methodological bases of human ecology (Bennett 1976, 1993; Moran 1979, 1990, 1993). It has incorporated the analysis of households and other institutions involved in resource-use (Netting 1993). More recently it has included the use of remotely sensed data and related techniques on land-cover change. To a great extent researchers were founding members of what has come to be referred as the "global environmental change scientific community."²² Cultural-ecological research on land-use dynamics conducted in the last decade has contributed for expanded spatial and temporal capabilities in the analysis of cultural events (Behrens 1991; Behrens et al. 1994; Casimir and Rao 1998; Guyer and Lambin 1993; Nyerges and Green 2000; Sussman et. al. 1994; Wilkie 1994).

²² This approach has also been conveyed through initiatives such as the Anthropological Center for Training and Research on Global Environmental Change (ACT) at Indiana University. For more than a decade, ACT has promoted interdisciplinary team-efforts to study issues such as differential rates of forest succession in the Amazon (Brondizio et al. 1994b, 1996; Moran and Brondizio 1998; Moran et al. 1994).

The “political” research approach situates land-use change within broader scenarios of socioeconomic and political transformation. The approach sees land-use from the perspective of multiple social actors in conflict over access and control of limited resources. As posited by Little (1999:255), land--and environmental degradation in general--are analyzed according to the interaction among political and ecological variables broadly conceived; operating at local, regional, national, and global contexts. Characteristic of developing countries, common themes addressed in this line of research are deforestation (Painter and Durham 1995), frontier expansion (Schmink and Wood 1992), struggles between ranchers and small farmers (Sheridan 1988; Stonich 1993), and conflicts between logging companies and local forest communities (Peluso 1991, 1992).

The “applied” approach sees land-use dynamics from the perspective of drastic environmental and cultural change. The approach links theoretical constructions to a focus on social protest against drastic livelihood changes provoked, for example, by encroachment, relocations, and resettlements of traditional peoples and rural, impoverished populations affected by harmful development initiatives (Guha 1989). Applied land-use research assesses increased social vulnerabilities, analyzing the objective (material impacts) and subjective (cultural constructions) aspects of the complex conjugation of physically and socially disruptive forces derived from drastic changes in human/environment interaction (Oliver-Smith 2001; Oliver-Smith and Hoffmann 1999). Another relevant sphere in this approach examines the effects of land-use change on traditional intellectual and material property rights (Posey 1999).

The “interpretive” research approach challenges universal frames of reference derived from scientific treatments to land-use. Interpretive formulations assess

worldviews about nature and culture based on people's perceptions of the way they use their resources (Dwyer 1996; Ingold 1994, 2000). The approach addresses in detail the subtle meanings, values, and feelings regarding spaces, places, and landscapes perceived, used, and interpreted by people ranging from isolated communities to societies already incorporated within modern ways of life and subject to the effect of development apparatuses (Escobar 1999). Other topics addressed in this line of research include, for example, traditional spiritual values that influenced behavior toward forest protection (Byers et al. 2001; Sahlin 1994), the coterminous degeneration of land and body (Williams 1997), and assessments of culture/nature relations through particular cosmologies (Descola 1994). Before integrating these approaches within a "grounded political ecology," I review the study of land-use in fields other than anthropology.

Land-use across other disciplines

Land-use dynamics is a central theme to geographers, who in many instances share theoretical perspectives and methodological protocols with anthropologists, especially the ecological and political approaches (less so the interpretive domain). On the one side, physical geographers who focus on the study of the earth's surface seek to identify, classify, and analyze the factors that transform natural landscapes and contribute to changes in biogeochemical cycles (Bahre 1991; Furley 1994; Singh et al. 2001). On the other side, the work of human geographers was critical to the understanding of land-use patterns across the globe. A seminal beginning was the research derived from von Thunen's (1966 [1875]) spatial model of concentric rings for agricultural land-use around urban centers. Geographers interested in land-use change addressed other questions such as the origins and domestication of crops (Sauer 1952), and accounts of the dynamics of agricultural change (Goldman 1993).

Cultural geographers have focused on land-use as economic strategies (Atkins et al. 1998). Others have produced ethnographic studies on the importance of land-use to social relations and cultural survival (Fondahl 1998). Still others worked on the concept of landscape as mediated through subjective, human experience (Cosgrove 1985). In the last two decades, geographers produced major contributions to the study of land-use dynamics. First, influential theoretical approaches were developed in the political ecology of resource-use (Blaikie and Brookfield 1987; Bryant 1992; Bryant and Bailey 1997; Peet and Watts 1996). Second, geographers actively engaged in the human dimensions component of global change research (Liverman et al. 1998; Turner et al. 1990; Meyer and Turner 1994; Walker 1999; Walker et al. 2000).

Rural economists (Kaimowitz and Angelsen 2001; Pfaff 1999) and sociologists (Pacheco 2002; Perz 2001; Wood and Skole 1998) have focused on the relation among population growth, technology, and land-use. Boserup (1981) asserted that increasing population pressure leads to adjustments in production that improve land productivity. Under well-functioning markets, technologies are developed for production on previously unused land, and more intensive production on farmland. Other economists address the extent to which people become more responsive to technological change as they lose income after land degradation, and people's strategies when facing new configurations of market, land tenure, and agricultural technology (Kirk 1999). Still others look at the economic costs of land-use and climate change, and to the related issues of efficiency, equity, and long-term impact of policy changes (Adger et al. 1997).

Political scientists that study land-use dynamics tend to focus on issues related to access to and control of resources, the effect of governmental programs and policies, the

role of institutions such as communities engaged in collective action, and the documentation of environmental activism. Environmental historians, for their part, use historical data to assess human populations that interact with their environments and influence patterns of vegetation change, with particular emphasis on the encroachment of Western civilization over native cultures (Goble and Hirt 1999; Wunder 1985). Regional planners address the topic mainly through the environmental, economic, and social impacts of sprawl development (Benfield et al. 1999), or the urban dimension of environmental change in forested areas (Browder and Godfrey 1997).

In the natural sciences, the joining of theoretical notions of resilience and adaptive cycles proposed by Gunderson and Holling (2002) has promising applications in the study of land-use transformations. Ecological approaches to land-use dynamics include biogeochemical research on the effects of human activity on natural systems (Bormann and Likens 1979; McClain et al. 2002), impacts of land-use and resource management in the dynamics of forest ecosystems (Puhe et al. 2001), and the effect of land-use change to soil (Richter and Markewitz 2001) and atmospheric conditions (Dale 1994). Agronomists and animal scientists are concerned with overgrazing, and the decline in crop yields.

Initiatives of the scientific and policy communities dealing with concrete aspects of global warming and climate change²³ are frequently related to the construction of integrated regional or global models informed by empirical assessments and comparative case studies. Such initiatives focus on land-cover change phenomena that affect broader ecological processes. Increasing urbanization, the expansion and intensification of

²³ Climate change is defined as a change of climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and that is in addition to natural climate variability over comparable time periods (Article 1 of the United Nations Framework Convention on Climate Change).

agricultural landscapes, and the construction of large-scale water reservoirs, for example, are related to deforestation, uncontrolled fires, loss or fragmentation of wildlife habitats, desertification, contamination of ground water, and wetland degradation events. Critical to this agenda are the examination of scientific and technical implications of carbon sequestration and the global carbon cycle, impacts of and adaptations to climate change, and alternatives for the mitigation of human-influenced emissions of greenhouse gases.

Given that global change research has been progressively considered a priority in the allocation and distribution of research funds, a growing number of international and interdisciplinary scientific endeavors have been established since the mid-1990s with this specific intent. Although the discourse highlights the integration of natural and social sciences, most of what has been done so far represents the integration of hard science with natural science, and relatively little social science. Programs in this sphere include the LUCC, the LCLUC, and the IPCC.²⁴ Other multidisciplinary scientific initiatives focusing on land-use dynamics and climate change are carried out through the LBA, the GEC, and the IAI.²⁵ Results of these programs and projects are published as institutional assessment reports based on drafts produced by the scientific contributors (Bruce et al. 1995; Houghton et al. 2001; Metz et al. 2001; McCarthy et al. 2001; Watson et al. 2000).

²⁴ The Land-Use and Land-Cover Change (LUCC) Project is maintained by networks of natural and social scientists, the International Council for Social Science (ICSU), and the International Social Science Council (ISSC). The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization and the United Nations Environmental Programme to provide an international assessment of scientific information on climate change. The Land-Cover and Land-Use Change (LCLUC) program is an interdisciplinary scientific theme, initiated in 1996 within NASA's Earth Science-Enterprise.

²⁵ The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) is an international research initiative designed to understand the climatological, ecological, biogeochemical, and hydrological functioning of Amazonia, the impact of land-use change on these functions, and the interactions between Amazonia and the Earth system. The Global Environmental Change (GEC) is a 10-year research program established in 1991 by the Economic and Social Research Council (ESRC) of the European Community. The Inter-American Institute for Global Change Research (IAI) is an intergovernmental organization established in 1992 by 16 American nations.

Having conceptualized the subjects of resource-use in this study, social stratification, and land-use dynamics--and with the intent to critically assess the dynamic and continuous processes that transform social relations and the biophysical landscape as parts of an integrated system--in the final section of this chapter I integrate these concepts within the proposed framework for the examination of socio-natural change.

Elements for the Construction of a Grounded Political Ecology

Political Ecology

Political ecology is an influential analytical approach that in the last two decades has integrated environmental and political understandings in social science research. As stated by Blaikie and Brookfield, "the phrase 'political ecology' combines the concerns of ecology and a broadly defined political economy ... encompass[ing] the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself" (Blaikie and Brookfield 1987:17). Inspired by the struggle of indigenous, peasant and other societies facing the expansion of capitalism, political ecology research has been conducted to study ecological degradation associated with intensified human impoverishment in consequence of interrelated social, economic, and political factors (Blaikie 1985; Little and Horowitz 1987; Redclift 1987; Schmink and Wood 1992; Stonich 1993). The approach has a strong application to policy analysis and formation due to its core agenda that focuses on contextual sources of environmental change (state policies, interstate relations, and global capitalism); the conflict over access, control, and use of environmental resources; and political ramifications of environmental

change²⁶ (Bryant 1992). Critical components of political ecological analysis include the understanding of a society's prevailing form of economic production and class structure, and the related ideological orientations to resource-use (Schmink and Wood 1987:39).

Particularly in ecological anthropology, what distinguishes political ecology²⁷ is that it "assumes that large social structures and political-economic processes will affect the actions of local resource-users" (Peluso 1992:51). Political ecology formulations emerged to fulfill the gap left by earlier theories in ecological anthropology and cultural ecology that, by focusing on human regulatory functions, did not consider history and the "political dimensions of human/environment interactions"²⁸ (Vayda and Walters 1999:168). In ecological anthropology, political ecology approaches claim that "local ecology has global links through economic forms that integrate places and people in a world-wide capitalist system" (Nyerges 1997:12). A common emphasis in political ecological investigations has been to integrate direct human actions and broader political and economic processes that impact the social and biophysical environment.

Event Ecology and Progressive Contextualization

It is in the treatment given to broad political and economic processes that most of the critiques of political ecological formulations reside.²⁹ Such critiques emphasize the deterministic treatment given to external causes that result in specific environmental

²⁶ Constructing a framework for political ecology research in the developing World, Bryant provides an extensive review of the literature and examines central analytical issues in each of these three areas of inquiry. For a review on the variations on the political approach, see also Neumann (1992).

²⁷ Eric Wolf (1972) was probably the first anthropologist to use the phrase political ecology.

²⁸ Stonich (1995:147) cites Bodley (1982), Durham (1979), Geertz (1963) and Moran (1981) as studies in ecological anthropology that, before the emergence of political ecology, observed the political dynamics of local populations and their articulation within broader structural spheres.

²⁹ But see also post-structuralist critiques advocating discursive approaches and greater emphasis on knowledge struggles in political ecology (Escobar 1999; Peet and Watts 1996).

degradation outcomes. Vayda and Walters (1999) have expressed an articulate critique of the approach, emphasizing the restrictive character and the a priori judgment made by political ecology investigators. Vayda and Walters posit that political ecologists assume in advance the deterministic role of politics or wider political-economic factors. The result, in their view, is to pay little or no attention to the nature of the environmental event in question, and to disregard important interactive factors leading to it. Although political ecological investigations look at the contexts through which resource-users interact with the environment, the authors challenge the attribution of ecological labels to what they predominantly see as studies on the political control or political contest over natural resources. They propose the alternative formulation of an event ecology, in which research should start “with a focus on the environmental events or changes that we want to explain and then ... work backward in time and outward in space to ... construct chains of causes and effects leading to those events and changes.” (1999:169).

Event ecology draws on Vayda’s previous methodological formulation of progressive contextualization, in which people-environment interactions are explained through the initial examination of “specific activities ... performed by specific people in specific places at specific times”, and by an investigation of causes and consequences of these activities” (Vayda 1983:266). Progressive contextualization is heavily inspired by the rationality premise, assuming individuals use their knowledge and available resources to achieve their specific objectives. Based on such a premise and through the practical interpretation of facts, the approach will lead to “concrete findings on who is doing what, why they are doing it, and with what effects” (Vayda 1983:276).

The approach shares with processual ecological anthropology (Orlove 1980) an emphasis on diversity and variability as outcomes of human/environment interactions, as affected by external constraints and opportunities. However, the framework overrates the role of individual rationality and decision-making models in the identification of adaptive mechanisms, underestimating conditions imposed by social structures (Jansen 1998:20) and downplaying agency in favor of rationality. As Jansen notes, human agency goes beyond simple adaptive behavior discerned by rational choice. Rather, human agency in this context comprises the inherent capacity of resource-users to dynamically assimilate and/or transform causation effects of “multiple social structures” (Jansen 1998:21).

Indeed, Vayda’s critique does not appropriately recognize the various lines of inquiry that have been produced through political ecological research. The chains of explanation proposed by Blaikie and Brookfield (1987), for example, begin by focusing on land-managers and their direct relations with the land, which are then linked to relations among land-managers themselves and with other groups, and ultimately with the state and the world economy (1987:27). The greater emphasis political ecology gives to social relations should not impede correct understandings of the environmental event itself. As Jansen shows in his work among Honduran farmers, local level investigations are critical to thoroughly understand the ways in which humans respond to different social attitudes, economic aims, and technical capacities. This understanding then permits “reappraisal, redefinition of functions, and development of new ways of exploiting land around them, while restating their relationship with it” (Jansen 1998:22).

Following up on Jansen’s assertion, I argue that political ecology and event ecology are compatible research agendas. Rather than note the contrast between them, I

see complementarity between the two approaches that may synergistically contribute to in-depth studies that respectively emphasize structural relations and environmental interactions. Vayda and Walters, by pre-establishing the primacy of environmental events, incur the same mistake of imputing a priori judgments determining research procedures. My contention is that one cannot pre-establish a deterministic relation, and cases exist in which each of the approaches is more appropriate to guide the enquiry. Yet, in the proposed framework, I argue for the cautious examination of a research problem according to multiple dimensions, or domains of explanation. I also suggest that structuration and practice theories offer a further harmonization between the approaches.

Practice Theory

In Outline of a Theory of Practice, Bourdieu (1977) presented concepts that have since then been influential in anthropology and sociology. Based on ethnographic observations in Algeria, Bourdieu develops a theory of practice that “seeks to define the prerequisites for a truly scientific discourse about human behavior” (Nice 1977:vii). The theory of practice and of practical mode of knowledge, as presented by Bourdieu, contrasts objectivist and practical knowledge of the social world, and asserts that the type of science based on the former is produced against implicit presuppositions of the latter.

Bourdieu integrates models of human behavior and suggests that the social setting and specific situations determine the basis of action. The understanding of behavior is viewed as an empirical issue, resolved only through practical observation, involvement and research. To Bourdieu, there are opposing categories in aspects of human life, with a dialectical relationship among them. As Wilk summarizes, Bourdieu sees “everyday life as an improvisation in which people work with rules and norms in a forward thinking strategic way, using their knowledge to pursue their interests.” (Wilk 1996:142).

Key concepts in the theory of practice are habitus and doxa. Habitus, defined as a set of assumptions, ideas and values formed and shaped by cultural experience, represents the common sense of how the world works. Produced by structures that form a particular type of environment, habitus functions as principles that generate and structure practices and representations collectively orchestrated without being the product of conscious obedience of rules (Bourdieu 1977:72). In traditional and stable societies in which the conditions of existence are little differentiated, the habitus is never questioned in any conscious way. When subjective principles of organization (the way people think about their social world) correspond with the objective way the world is structured, natural and social worlds appear as self-evident, constituting doxa. When doxa prevails, there is no choice, because people see no options for the course of action. In contrast, orthodoxy occurs when powerful interests impose a single choice to people, who, however, became aware of antagonistic alternatives. A distinct condition, heterodoxy, occurs when people recognize more than one possible course of action, rules or meaning. Bourdieu argues for a dialectical relationship among culture, social structure, and self-interest resulting in the building and maintaining of doxa, or in the imposition of orthodoxy.

The Ecology of Practice

Preexisting social relationships, hierarchies, and the agency of individuals are thus central aspects of practice theory, an approach that emphasizes the character of social and cultural contexts as both medium for and outcome of the reproduction of practices by individual actors (Nyerges 1997:8). Based on the anthropological derivations of actor-centered and practice models of human action (Orlove 1980; Ortner 1984; Vayda 1986), the formulation developed by Nyerges (1992, 1997) appraises individual agency in everyday social life as directly involved in the generation of practices that result in

resource competition, control, and exploitation. The approach examines how conflicts emerging over access to and control of resources are incorporated into individual social lives, and alter the exploitation and management of specific resources.

Focusing on the ecological significance of local socio-political dynamics, the ecology of practice relates the position of individuals in local social hierarchies to the culturally constructed mechanisms (and productive activities) adopted to exploit natural resources on which they depend (Nyerges 1996:123, 1997:7-10). According to this approach, it is the position of individuals within established social orders that determines specific outcomes of their relationship with the environment (Nyerges 1997:9-10).

The ecology of practice emphasizes the incorporation of processes of ecological adaptation into social interactions and practices among resource-users, and examines environmental consequences of individual efforts to achieve and sustain socially defined management goals in the context of established social structures. Nyerges' translation of practice theory to ecological anthropology can be seen through his work with Susu agriculturalists in Sierra Leone (Nyerges 1992, 1997), in which management strategies are shaped by heavily institutionalized social asymmetries within a hierarchical system.

Grounded Political Ecology

Through the formulation of a grounded political ecology, while I draw on Nyerges' ecology of practice to explain mechanisms through which resource management strategies respond to local socio-structural conditions, I expand the focus of the ecological significance of socio-political dynamics to levels other than the very local. Grounded political ecology employs an analytical framework that is guided by a problem-centered approach and combines multiple domains of explanation (presented in this chapter's initial section) that are able to capture the temporal and spatial cross-scale

dynamics involved in socio-natural transformations. I contend that the approach is therefore effective to study the socio-cultural and political-ecological dimensions of resource dynamics and land-use change. Land-use dynamics and related trends of social stratification within resource-users in Lago do Junco have been, as Bourdieu would say, a “practical answer to the practically, historically situated problems which were forced on them in a determinate state of their instruments of material and symbolic appropriation of the world.” (Bourdieu 1977:115). The remaining chapters of this dissertation provide an in-depth examination of this case.

CHAPTER 3

LAGO DO JUNCO: SOCIOECONOMIC CONFIGURATION

When I first arrived in Lago do Junco 15 years ago, I had limited awareness of the degree of socio-cultural heterogeneity within communities in the area. On the basis of my knowledge at that point, such heterogeneity was overshadowed by greater contrasts between peasants and ranchers. Yet, while noticing few differences across households and communities, I began to ask myself how these resource-users were likely to face the evident erosion of their production capabilities in the near future. By the mid-1980s, peasant livelihood in Lago do Junco was severely constrained by the cumulative effect of a well-known sequence of events and processes. This sequence began with specific conditions activating power differentials and the expression of social inequalities. That led to the concentration of landownership, and to a scarcity of means of production for most households. In a socio-natural ensemble formed by highly connected socioeconomic and biophysical systems, processes of social stratification directly affected ecosystem integrity and resource-management. The results were a natural system, with extensive areas of pastureland, and fragmented patches of secondary forest used for shifting-cultivation. In the latter, fallow periods had to be shortened. That provoked a decline in soil fertility, lower yields, and exacerbated inequalities. For peasant producers this meant that drastic efforts were needed to attain even a minimal level of subsistence.

In order to understand socio-natural transformations in Lago do Junco, we have to investigate the extent to which changes in the social system resulted in the adoption of

alternative forms of land- and resource-use, and the implications of these transformations for ecosystem functioning (issues addressed in Chapter 4). We also need to better comprehend the determining factors that, at multiple analytical scales, restructured the social system. In the specific case of the peasants of Lago do Junco, we need to unravel the underlying factors leading to economic differentiation and social stratification.

In this chapter I present the sequence of events and historical facts that led to the current socioeconomic configuration in Lago do Junco. I begin with a contextualization of the broader setting, and of social relations in the entire municipality. I then examine processes of socioeconomic differentiation in São Manoel and Pau Santo, informed by relevant events of the past. This analysis attempts to portray the dialectics of negotiation among heterogeneous individuals and groups for their continuity in a given place. This does not rule out situations in which the subjects themselves find it appropriate to dynamically change their positions when negotiating their role in a given social structure.

Municipality of Lago do Junco

Pau Santo and São Manoel are villages in the countryside of Lago do Junco, a small municipality¹ between the Mearim and Grajaú rivers of central Maranhão. In what follows, I present aspects of Lago do Junco's economy and society, including the recurrent contestations that characterize social relations in rural and urban spheres. Given the dynamic changes in the spatiality of relationships involving town and country in the region, oppositions expressed in the urban sphere have important effects on processes of social organization, economic differentiation, and resource-use in the countryside.

¹ The municipality (município) is the smallest autonomous political unit in Brazil, composed by an urban administrative center and rural areas. Municipalities with more than one urban center might be subdivided in districts (distritos). In Maranhão, given the peculiar pattern of land occupation, rural areas most often include several villages, the largest ones with a limited urban infrastructure.

Historical Background

Non-indigenous people first occupied lands that today correspond to the town of Lago do Junco in 1925. Maria Pretinho, her four grown children, and an accompanying teenager arrived from Grajaú, an area of early occupation and cattle expansion in southern Maranhão. They intended to settle down on better-watered, forested lands suitable for agriculture. Once in the region, and after receiving directions from an “Indian” they encountered close by, the pioneers decided to settle near a small lake covered with a strawgrass locally known as junco,² after which the site was named.

The occupation of lands around Lago do Junco resembled the expansion of the peasant frontier in the state described in the Brazilian anthropological literature (Almeida 1974:16-21; Velho 1972:224-225). As Almeida (1989:187) notes, people established their annual fields with no private appropriation of land, and no obligation of territorial continuity. Hamlets, known as centros, were initially limited to the pioneer’s dwelling next to clearings for annual crops (roças). These centros gradually expanded upon the arrival of family members, friends, or other people seeking “free,” forested lands and who became aware of opportunities offered by new settlements. Convenient for both the pioneer in need of labor force to expand his activities, and for those newly arrived in need of start-up support, such cases involved a great deal of labor exchange. Yet, in certain occasions, small rental payments were made to acknowledge early settler’s tenure rights.

Gradually, Lago do Junco became a larger village along the route of cattle herds brought from Goiás or southern Maranhão, for slaughter in the state capital. By the

² Of the several strawgrass species known as junco in Brazilian wetlands, the most important economically is *Juncus effuses*, of which fibers are used in crafts and furniture. The species more often referred as junco by peasants in the Mearim valley is *Typha latifolia*, a common cattail also known in Brazil as taboa.

mid-1940s, Hosano Gomes, one of the individuals who arrived after initial settlement, became involved in commercial and processing operations. Hosano assumed the role, and even the name, of coronel, the local economic and political chief. At that time, a few other centros in the vicinity became larger villages. Through commercial bonds with pioneers in those villages, Hosano Gomes progressively achieved political influence. In the meantime, Lago do Junco assumed rudimentary urban functions at this very local level. The role of coronel Hosano emerges in the recollections of Doni Arruda, a resident of Lago do Junco since 1936, who became a landed rancher in the late 1950s.

[Doni] "Nobody knew anything here. The only one who knew was the late Hosano. He used to take the boat to buy supplies in São Luís. He unloaded in Bacabal or Pedreiras, and from there on, all was taken on donkeys' back. It was big trouble during the winter. He was the one who brought us barbed wire, and revolvers. At that time people really enjoyed using guns! He brought things for us to pay for with the harvest, with our rice."

For almost four decades Lago do Junco remained under the administrative and legal auspices of IPIXUNA (currently São Luís Gonzaga do Maranhão), the region's oldest municipality, established in 1854. Land partition and political autonomy occurred only in 1961, when the state governor choose Narciso Rodrigues as Lago do Junco first mayor. Subsequently, the voting of 1963 ratified Hosano Gomes as the first elected mayor.

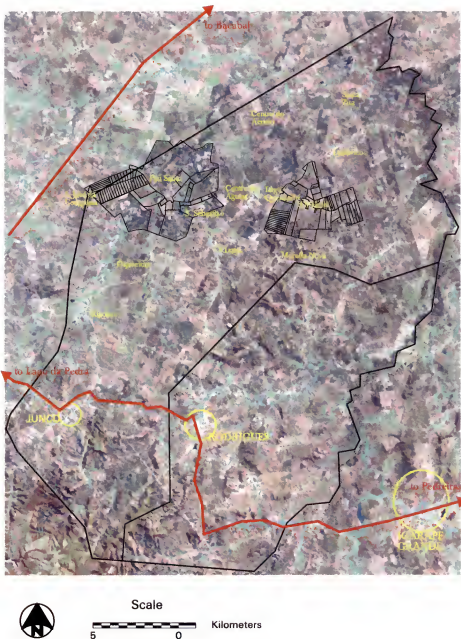
Political autonomy coincided with a period of greater economic differentiation and the subordination of rural people to local elites. The concentration of wealth and power within a handful of Lago do Junco's families was possible through commercial exploitation, illegal land appropriation, and the channeling of government incentives. From the early 1960s to the late 1980s, the Arruda, Leda, Gomes, Albuquerque, and Pinheiro families acquired the status of urban resident, rural elite. In the last two decades, the Arruda and Leda families became the main protagonists of an intense power dispute.

Lago do Junco's territory did not change in the three decades that followed political autonomy. By 1994, Lago dos Rodrigues--a district 8 kilometers to the east--had outgrown the municipality's administrative center as its largest urban settlement. In that year, as concerned local elites in "Rodrigues" enacted similar processes of socio-political and economic differentiation, Lago dos Rodrigues was politically separated from Lago do Junco. The change subtracted 16% of the territory and 45% of the population of the latter.³ Indeed, since the 1970s the town of Lago do Junco has languished, partly because of commercial developments in Lago dos Rodrigues, but mainly due to the greater urban expansion of Lago da Pedra, 10 kilometers to the west.

Socioeconomic and Demographic Features

Today Lago do Junco remains a predominantly rural municipality. In addition to the town, Lago do Junco comprises 36 villages, 10 of which (including Pau Santo and São Manoel) have more than 50 habitations, and populations greater than 300 people (Figure 3-1). In year 2000 the population of Lago do Junco reached 9,833 inhabitants (in 597.4 km²), and 71% resided in "rural" areas. A rural household in Lago do Junco included an average of 4.7 people, as opposed to 4.3 people for urban households (IBGE 2001a). The town is stretched along a 2-kilometer main street (asphalted in 1988), and half a dozen secondary roads, paved more recently. Lago do Junco also has its own small suburban neighborhoods, the Piçarra and Rabo da Gata, which are low-income areas with modest habitations and limited urban services, resembling isolated countryside villages.

³ A massive transformation in the political boundaries of Brazilian municipalities took place in 1994-95. In the state of Maranhão alone, 81 new municipalities were created, increasing the state total from 136 to 217. The new political boundaries are not yet completely set. The post-1994 total area of Lago do Junco, for example, has been reported differently according to distinct sources, even within IBGE.



Landsat ETM+ (August 2001)

5-2-1: RGB Composite

Figure 3-1. Map of Lago do Junco showing the town and villages in the countryside

The economy is mainly based on rice production, babassu extraction, and cattle ranching.⁴ While a few mid- to large-landowners engage in ranching, a substantial part of even the urban population relied on crops and babassu for their livelihood. Suburban residents, for example, sharecrop on lands elsewhere in the municipality, or in isolated, forested areas towards the south. In Lago do Junco there is no manufacturing industry and no bank, and commerce is restricted to basic items sold in a dozen stores. In contrast to the frenetic early morning movement around markets (mercados) in neighboring cities, only a few vendors and sporadic customers visit the building that houses Lago do Junco's mercado. More recently, commercial movement in the city increased with a weekly fair that operates every Friday on the town's main street.

The City (prefeitura) is the main labor contractor, with 342 employees in 2002, most of them receiving minimum wage. Transfers from state and federal governments are the main sources of revenue. In July 2002, the Municipal Participation Fund received in Lago do Junco was US\$66,000. As is common to small and mid-size municipalities in the Brazilian Amazon and Northeast, the opportunity to access and control these resources prompted fierce disputes over political offices ever since the municipality was created. Such disputes, however, resulted in very limited gains for the population in the social and infrastructure areas: A single ambulatory unit provides limited medical care. Secondary education is only offered in one school with scarce human and material resources to assist less than 120 students, and only 7% of urban dwellings were connected to sewage systems by the year 2000 (IBGE 2001c). Figure 3-2 shows landscapes and the urban environment in the town of Lago do Junco in 2001-2002.

⁴ In the 1996-2000 period, the municipality produced an average of 1,683 tons of rice and 1,866 tons of babassu nuts. A 8,325 cattle herd was being raised in Lago do Junco in the year 2000 (IBGE 2001b).

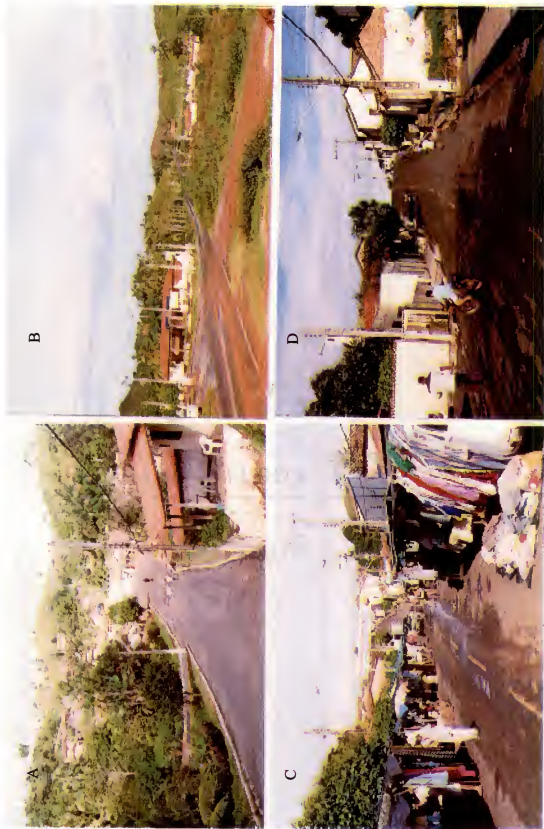


Figure 3-2. Images of Lago do Junco. A) Main street. B) City entrance. C) Weekly fair. D) Other view of main street.

Markets, infrastructure, and accessibility

Regional markets and urban centers are Bacabal (located 70 kilometers to the north of Lago do Junco), Pedreiras/Trezidela (60 kilometers to the east), and Lago da Pedra (10 kilometers to the west) (see Figure 1-1). In the year 2000, the urban population in these cities was respectively 70,000, 45,000, and 25,000. The road connecting Lago da Pedra to Pedreiras (MA-122), passes by Lago do Junco and half-dozen other towns that supply a secure clientele to formal and informal modes of passenger transportation. Very little merchandise or services are available locally, and intense traveling occurs. Twice a day buses travel to São Luis (the state capital), and Teresina (capital of the state of Piauí), both at 300 kilometers or roughly 6-hour trips. The routine of these towns is further energized by a fleet of independently owned second-hand minibuses, fairly new mini-vans, and dozens of “moto-taxis” that serve the rural and urban population for shorter trips, or to access bus stations at BR-316 highway in Bacabal or Peritoró.

The economic stimulus provoked by roads is a phenomenon underway in the region since road improvements in the 1960s. Prior to that, the regional economy gravitated around the Mearim river. The river was navigated by steamboats using major ports in Barra do Corda, Pedreiras, São Luis Gonzaga, and Bacabal. These ports were critical for the transportation of rice, cotton, and babassu from central Maranhão to the state capital and beyond. The paving of BR-316 in the 1950s connected the markets of the Brazilian North (Belém) and Northeast (Fortaleza, Recife), and replaced the river as the most important means of transportation. Road construction shifted urban development and demographic growth from Pedreiras to Bacabal. While Pedreiras’ annual index of urban demographic growth decreased from 8.1% in the 1940s to 3.3% in the 1950s, Bacabal’s increased from 1.6% to 12.1% in the same period (Musumeci 1988:230-232).

Spheres of conflict and confrontation

Conflicts among social segments in Lago do Junco are expressed across distinct categories, ranging from family membership and place of residence, to ideology and social class. The presentation of oppositions manifested in the urban sphere introduces individuals, families, and institutions directly connected to the peasant communities being focused by this study. In addition, these conflicts are useful to understand similar processes that occur within those peasant communities. Three spheres of contestation are evident: the spatially-bonded conflict between power holders in Lago do Junco and Lago dos Rodrigues; the dispute for political and economic power between two families of Lago do Junco; and the confrontation between landed elites and landless peasants. Taken together, these confrontations tell a great deal about social relations in Lago do Junco.

A spatially bonded rivalry between elite groups. Perhaps the sharpest of Lago do Junco's oppositions emerged in the open confrontation in the 1980s between politically leading factions in Lago do Junco and Lago dos Rodrigues. The administration of the municipality was transferred to Lago dos Rodrigues in 1983, stirring up the anger of Junco's elite. A member of one of Lago dos Rodrigues' wealthiest landed families took office in that year, becoming the first female mayor of Lago do Junco. Rodrigues was already "more developed" than Junco, but the power transfer increased the extant rivalry between elites of these two towns. Those holding hegemonic positions successfully drew in people who would not necessarily be affected by such changes, turning the rivalry into a spatial confrontation. The transfer of resources and services to Lago dos Rodrigues resulted in economic losses for Lago do Junco. The rivalry included bizarre situations, such as positioning the television antenna in such a way that just Rodrigues' families, and nobody from Lago do Junco, received images of the only regional broadcast.

Tragic features of this confrontation included the murder of Gonalo, the mayor's husband. Gonalo was the political chief, but legal impediments precluded him to run for mayor, being replaced by his wife Marly. Gonalo killed an opposing city commissioner (vereador) while the latter was casting his vote in the 1982 municipal election. A few years later, Gonalo was killed in retaliation, and soon thereafter, the mayor's brother and one of her sons were also murdered. During the early 1980s, 36 people were killed in connection to the power dispute in Lago do Junco. Marly herself suffered a murder attempt that left her with a facial prosthetic device as a permanent reminder. To illustrate the intensity of this confrontation, it is worth noting that despite living in Lago do Junco for the last two years of her term, I recall having seen the mayor only once! An armored van with tinted windows is the first image that comes to mind when I recall mayor Marly Barbosa. Like most of her forerunners and successors, she spent most of the time in the state capital, where she owned a hotel. Her family owned a ranch in Barraquinha, a village 5 kilometers east of Lago dos Rodrigues. Her forced seclusion influenced the outcome of the 1988 election, when the Barbosas lost the election. Victorious, the Leda family was able to transfer city administration back to the town. Internal disputes within Lago dos Rodrigues itself precluded the Barbosa family to regain political hegemony since the new municipality was created.

Inter-familial rivalry. A discontinuity in the chain of power took place in Lago do Junco in the mid-1970s. Upon the death of the coronel Hosano in 1974, the family sold their urban property to the Catholic Church. Hosano's children had already moved to the state capital. Indeed, a common practice among local elites in Maranho is to have a second residence in So Lus (or other capitals, such as Braslia, Fortaleza, and Teresina).

In addition, male children (mostly) move to these capitals to get an education, mainly to study medicine, but also law, dentistry, agronomy or veterinary medicine. The pursuit of a medical career was a strategy particularly espoused in Maranhão to maintain local elites' economic and political hegemony in the face of a declining rural economy (Nunes 2000). Upon college graduation, most return to their hometowns to establish practices. Medical doctors build private hospitals or health clinics benefiting from a close association between political power and the ability to channel (and divert) significant resources intended for the health sector. Hosano Gomes' heirs, however, remained in São Luís and established there their medical practice. One of them returned only recently. He practices medicine, but is said to have the alleged intent of running in the 2004 election.

The nearly three-decade absence of Hosano Gomes' heirs has opened the way for a family-based power dispute involving those that were hitherto relegated to supporting roles, with little political claims, while being overshadowed by the presence of the coronel. This confrontation is presently underway, having as major protagonists the Leda and Arruda families, both natives of Grajaú.

The Arruda was a family of five siblings (Pedro, Doni, Oswaldo, Newton, and Didácio [Didi]) who arrived with their parents Juca and Júlia in 1936 from Grajaú's Serra Negra. Established in Lago do Junco, they began to explore lands near Pau Santo and São Manoel, at sites named Lagoa da Lata and Santa Luzia, 20 kilometers from the town. Upon marrying in 1951, Doni moved to Lagoa da Lata, where he spent just over a decade, returning to the town in 1962. Pedro, Doni and Didi kept commercial links with Grajaú, and later with the Bananal Island in Goiás, where they bought cattle to sell to slaughter houses in the state capital, or to ranchers in the Mearim Valley. With the 1960s

state-motivated land privatization in Maranhão, the Arrudas were able to claim private property in Lago do Junco. They progressively converted land to pasture with bank support, becoming cattle ranchers themselves. Didi went even further. He engaged in the illicit appropriation and irregular registration of landed property with the intent to sell to others, usually with the complicity of notary offices (*cartórios*). Yet, in 1971 Didi replaced Hosano Gomes as Lago do Junco's second elected mayor. It took 25 years for another member of the Arruda family to take office again. Ribamar, who is Didi's nephew, has been the mayor since early 2001. Presently, adult children and in-laws of Pedro, Doni, and Didi Arruda comprise more than 80 people (and voters). When they coadunate their interests, the family is able to politically control Lago do Junco.

The political unity of the Arrudas was undermined during the administration of Haroldo Leda, a two-time mayor (1989-1992, 1997-2000), and main representative of the other protagonist family in Lago do Junco's dispute for political leadership. Haroldo's father was Leão Leda, nephew of Hosano's wife. Leão was a descendent of a liberal ranching elite in the south of Maranhão. His ancestors engaged in armed struggles against conservative monarchists (Abranches 1993). Leão, however, did not pursue a political career. He claimed lands on the southern part of Lago do Junco, an area called Cipó. There he established a ranching operation in the late 1960s. Educated in São Luís as a medical doctor, his son Haroldo returned to Lago do Junco for the 1982 election. Upon his political loss to Marly Barbosa, and given the acute crisis related to the violent murders of the Barbosas, Haroldo moved to Brasília where he spent additional six years.

Haroldo's victories in the next three elections provided him political control in the 1988-2000 period. After his first term as a mayor, Haroldo was legally barred from

running again. Leda agreed to support a successor from Lago dos Rodrigues who was opposed to the Barbosas. The new mayor granted Haroldo a good share of the actual administration. Elected again in 1996, Leda's influence arose with his nomination as president of the Association of Mayors of Maranhão's Municipalities, with close rapport with the state governor. After his loss to Riba Arruda in 2000, the governor nominated Leda for a position in the state administration, which he currently holds. Hamilton, who is Leda's brother, remains in Lago do Junco as the highest voted city commissioner.

This dispute has marked Lago do Junco's political environment in the past two decades. Rather than being limited to the political sphere, the dispute guides social relations that are expanded to villages, and reach the economic domain. Even in 1988, when the Barbosa family was their "common enemy," the two sides ran separately, to the benefit of Leda. Once the dispute with Lago dos Rodrigues was no longer an issue, Leda defeated the Arrudas again in 1996, but not in 2000. In this last election, the Arrudas regrouped not only through an alliance with urban groups hitherto loyal to Leda, but also with the "organized" peasant social movement. The mention of a peasant sector brings up the third critical confrontation featured in Lago do Junco's society, presented next.

Communities in *mutirão*: rural workers' struggle for tenure rights. In addition to the political patronage exerted by Hosano Gomes, and later by the Arruda, Leda, and a few other families, villagers in Lago do Junco were subordinated to nearby wealthier ranchers, who were treated as local patrons. Part of these ranchers were better-off peasants who benefited from skills, opportunities, or connections to differentiate themselves from their peers. Some engaged in politics, and were elected city commissioners. Others connected to the urban elite through strictly economic means,

acting as middlemen for larger city merchants. Later, a number of these local ranchers sold their property to outsiders.

Benefited by the loyalty of co-opted representatives in the villages, and counting on power connections at regional and state levels, these local elites established social and economic relations that combined features of northeastern coronelismo with Amazonian debt-peonage. The result was a threat to peasant existence. Villagers did not even exert full citizenship rights. They were precluded by clientelistic practices ranging from the provision of food and transportation on special occasions, to the access to basic civil benefits (such as birth or marriage certificates), or the sponsoring of financial credit from the bank. Yet, as long as a certain social reciprocity was maintained, sporadic benefits were enough to distract peasants from a full awareness of this exploitative condition.

By the mid-1980s an additional ingredient was introduced into Lago do Junco's social fabric. Most of the peasant population had lost tenure rights, and found themselves with few resources to ensure a livelihood. The conversion of land to pasture eliminated several villages, or reduced them to a handful of semi-proletarian families. Consequences of pasture conversion, coupled with the reduction of acts of social reciprocity by ranchers could have been worse were it not the existence of babassu as a source of petty income.

During the 1960s and 1970s, dispossessed peasants from Lago do Junco and other areas of older occupation moved further west, in search of lands in more remote sites in Maranhão or in the state of Pará.⁵ But better quality and accessible lands were no longer available even in those locations. The frontier alternative became less attractive in the

⁵ Maranhenses form a significant proportion of colonists settled in the early 1970s through official colonization schemes in the Transamazon. In addition, the progression of this dispossessed peasantry also occurred through spontaneous occupation of lands beyond official schemes in the state of Pará, and through the occupation of lands in western Maranhão, in the Pindaré valley near the Carajás railroad.

mid-1980s, made worse by the deterioration of Brazil's macro-economic situation that meant fewer incentives and a higher cost of spontaneous colonization. Although mining became a popular site for the allocation of labor early in the decade--mainly the gold rush of Serra Pelada--internal contradictions in the Mearim reached the point of social unrest.

Social consciousness began to spread through the work of evangelization of Catholic missionaries of the Bacabal diocese. Since its creation in 1968, the diocese had been under the control of Franciscan friars from the German province of Saxony, who in 1952 had funded a chapter in Bacabal. Guided by premises of liberation theology, steps in this process began in the late 1970s. They included courses for peasant leaders, through the activity of ACR (*Animação Cristã no Meio Rural*, the Energy of Rural Christians), and MER (*Movimento de Evangelização Rural*, the Movement for Rural Evangelization). These groups sponsored regional meetings to raise collective consciousness and support the establishment and empowerment of base communities (*comunidades de base*). This process set in motion actions that contested the exploitation that was taking place, and targeted the recovery of land tenure for peasants who had been dispossessed. Community organization was just the initial step of a broader process that evolved into peasant labor unions and party politics, and the creation of civil initiatives, such as cooperative and collaborative grassroots movements. The process brought about profound changes in social relations in Lago do Junco, and transformed the approach through which the population viewed peasant leadership and the Catholic Church.

Since the mid-1980s' Franciscan support for the struggle of a community in Lago do Junco (the *centro do José Machado*), peasants began to be viewed with suspicion by local elites--and by low-income urban people influenced by them. They were seen as

bandits dominated by outside communist agitators. The term *mutirão*, for example, was long used by peasants to designate mutual support among communities. Local elites understood the term to mean a collective gathering of bandits who threatened private property. To the likes of Arruda, Leda, and Barbosa families, there was no doubt that the architects of the uprisings were the German priests in Bacabal and Lago da Pedra, notably friars Adolfo, Eriberto, and Godofredo. In a highly Catholic society such as rural northeastern Brazilians are, changes in the role of the Church as an institution affected the habits of elite members who had to reassess their participation in the parish and, indeed, their entire conception of the church. The hitherto active participation of (mainly) women of the elite families in church-sponsored activities turned into a formal, nearly forced relationship. Men who anticipated harsh words about social injustices during sermons simply avoided going to church when priests attended the service.

While the German friars still held some respect, the same was not true of peasant leaders of the *mutirão*, who were viewed with dissatisfaction and even censure while in the city. As land conflicts progressed, families that remained in the villages of Pau Santo, São Manoel, Ludovico, and Centro do Aguiar, were considered part of the “banditry.” In sum, the dispute for resources achieved proportions of a class-like confrontation between *haves* and *have-nots*. To better understand the extent of such opposition, the next section details the status of concentration of landownership in Lago do Junco.

Agrarian Issues and Concentration of Landownership in Lago do Junco

Resource-use in Lago do Junco and in most of Maranhão is constrained by a high degree of concentration of landownership. The moderate demographic densities in the municipality (16.5 inhab./ km²) and in the entire state (17 inhab./ km²) are misleading figures. In areas that remain occupied by peasants, land concentration critically increases

de facto population pressure on resources. Table 3-1 shows that 89% of Lago do Junco landholdings⁶ were smaller than 50 hectares (1,388 units, for an estimated population of 6,524) and occupied an area of just 5,583 ha. If we assume restriction of access to private property, population density in these areas rises to about 120 people/km². Indeed, one third of the 1,567 landholdings in the municipality were smaller than one hectare in 1996.

Table 3-1. Total area and number of landholdings, and tenure security in Lago do Junco according to groups of size of landholding, 1996

	< 1 ha	1-10 ha	11-50 ha	51-200 ha	201-500 ha	> 500 ha	Total
area (ha) of landholdings	361	1,561	3,661	11,772	7,870	8,628	33,854
(%)	(1.1)	(4.6)	(10.8)	(34.8)	(23.2)	(25.5)	(100)
number of landholdings	525	689	174	143	29	7	1,567
(%)	(33.5)	(44.0)	(11.1)	(9.1)	(1.9)	(0.4)	(100)
landholders with tenure security	32	111	142	129	22	7	443
landholders with no tenure security	493	578	32	14	7	0	1,124

Source: IBGE 1998

Note: The table is based on categories employed by Brazilian censuses (proprietários, arrendatários, parceiros, and ocupantes). The table classifies landowners (proprietários) as landholders with tenure security; and renters (arrendatários), sharecroppers (parceiros), and squatters (posseiros, ocupantes) as landholders with no tenure security.

Table 3-1 also shows that in 1996 only 20% of the landholdings smaller than 50 hectares (285 out of 1,388) were held by producers with tenure security. Most of the smaller areas were held by peasants from villages near ranches, or from the periphery of the town. Conversely, 7 estates (just 0.4% of the landholdings) occupied 25% of the land.

⁶ Land concentration data were obtained from IBGE's 1995-96 agricultural census and refer to the municipality of Lago do Junco before the dismembering of Lago dos Rodrigues. Landholding is the translation for estabelecimento agropecuário, a concept employed by IBGE, defined as "every continuous land area—regardless of size, location, and number of parcels—used by an individual landholder for agricultural purposes" (IBGE 1998:21). These estabelecimentos do not always correspond to the total number of households that live and work in rural areas. The comparative analysis of number and area of estabelecimentos agropecuários, however, still is the best proxy to examine land concentration in Brazil.

These numbers reflect the agrarian situation of a municipality where a rural elite of less than 40 landholders (with areas greater than 200 hectares) controlled half of the territory. This elite can be further disaggregated into two groups. Seven landholders held title to estates larger than 500 hectares. These are businessmen with few ties to Lago do Junco. They have markedly urban lifestyles, with interests in other branches of the economy. One estate belongs to a corporation from Ceará, another is owned by a retired military man from the same state. Still another in this group belongs to Rubens Melo, a physician who in addition to owning 1,250 hectares in Lago do Junco, also owns other properties in Lago da Pedra, including ranches, a hospital, a brick factory, and a hotel.

Some of the landowners who own property between 200 and 500 hectares reside on their ranches. Others have residences in the city. Still others live in nearby cities such as Lago da Pedra or Bacabal. In general terms, they are more attached to the region than the large ranchers, and livestock is their major source of income. Although a few seek to intensify operations, they are mostly traditional, low-level technology, extensive ranchers. This is the category typical of local elites, and the wealthier peasants who became ranchers since the 1960s.

Positioned between Lago do Junco's landed elites and the dispossessed peasants with very little or no land, an intermediate category of some 300 resource-users own property ranging from 10 to 200 hectares. Most of these small and mid-size producers (*pequenos e médios produtores*) live on their land and integrate annual cropping with cattle raising, the latter being the primary activity for those with greater resources. Agriculture is more important among those with smaller areas, who also engage in babassu extraction. This group includes peasants who claimed private property in the

1960s, and others who recently entered the process of economic differentiation. It is already possible, however, to identify estates that are fragmented after the passing away of the original landowner, with the land being distributed among heirs.

Table 3-1 did not include peasants settled since the mid-1980s on lands expropriated, acquired, or adjudicated by the state, nor those lands recovered through direct negotiations with landowners or through the mediation of the Church. Prompted by an active social movement, a sequence of land conflicts has reduced concentration of landownership in Lago do Junco. In quantitative terms, the mobilization over the last two decades resulted in significant recovery of land by peasants in Lago do Junco. Eighteen estates totaling more than 6,000 hectares were recovered, directly benefiting some 450 families, with an average of 13 hectares per household, as noted in Table 3-2.

Table 3-2. Chronology of land tenure recovery by peasant producers in Lago do Junco

Year	Name of estate/property	Size (ha)	Families	Mechanism for tenure recovery
1980	São José da Conquista	448	32	Purchase / church intervention
1985	Pau Santo	1,014	50	Expropriation (federal govern.)
1986	São Manoel	470	31	Acquisition/Adjudication (state)
1987	Aparecida de Ludovico	369	33	Acquisition (state government)
1987	Santa Zita	150	18	Acquisition (state government)
1988	Cajazeiras	125	12	Purchase / church intervention
1989	São Sebastião	230	12	Adjudication (state government)
1989	Centro do Aguiar	203	20	Acquisition (state government)
1990	Centro do Acrísio	194	24	Donation by rancher
1990	O. D'Água (Endrex) Altamira	510	82	Acquisition (state government)
1994	Sítio Novo	231	14	Acquisition (state government)
1994	Macaúba	80	10	Acquisition (state government)
1994	São Domingos	200	15	Acquisition (state government)
1995	Santa Rita	459	15	Expropriation (federal govern.)
1996	Vila São João	268	20	Expropriation (federal govern.)
1996	Vila São Francisco	396	15	Expropriation (federal govern.)
1998	Vila São José (Lagolândia)	90	8	Adjudication (state government)
2001	Fazenda Alegria	565	35	Acquisition (state government)
Total		6,002	446	

Source: Lago do Junco rural workers' union (personal communication)

Note: Year in the first column refers to the beginning of the land struggle or negotiation

The process shown in Table 3-2 indicates that intense agrarian transformations are still taking place in Lago do Junco. In fact, to say that such processes are underway is backed up by a land struggle that resulted in two fatalities in 2001. The state government is acting to purchase Alegria, a 565-hectare estate that limits São Manoel and Pau Santo lands. The recovery of these lands will grant the spatial continuity of peasant settlements to 13 areas in almost 4,000 hectares. These transformations express new nuances of social and economic differentiation, which result in profound ecological consequences.

The remainder of this chapter discusses the sequence of processes and events that led to the current socioeconomic configuration in the area, and analyzes the trajectories in Pau Santo and São Manoel. Before doing so, it is worth noting the circumstances of my entrance into the latter community (I mentioned my introduction to Pau Santo in the Preface). I first visited São Manoel during the acute moments of a confrontation between villagers and a wealthy landowner. Families were displaced, and their houses destroyed. People were hiding in the forest, while collectively planning how to regain tenure rights. In August 1986, I attended one of these meetings in which the community, helped by neighboring villagers, gathered beneath the orchard trees of one of São Manoel's oldest residents. If in Pau Santo I was amazed to learn of episodes of their tragic confrontation, in São Manoel it was more dramatic still. I witnessed firsthand how people were visibly anxious about the surrounding noises (and silences), as they fingered ancient shotguns. Tales of their dramatic history lasted well into the night, as we lay in hammocks tied to hilltop trees. The experience was a bonding event that provided me an insiders' view of daily life among these people. While this vantage point can, at times, shade an interpretation of the events, it also serves as an invaluable premise for objective analyses.

Pau Santo and São Manoel: Departing from a Single Peasant Trajectory

Pau Santo and São Manoel are peasant communities with similar characteristics. They share a history of land occupation, a traditional mode of agro-extractive production, and their 1980s' struggle for land against cattle ranchers. Despite these similarities, the communities are different. To understand the distinctions between the socioeconomic configurations in Pau Santo and São Manoel, an initial clarification is needed with respect to the terminology that I employed when referring to these sites.

Villages, Communities, and Settlement Areas

Each of the names (Pau Santo and São Manoel) refers to three distinct although complementary usages. For São Manoel, the first usage refers to the physical location of one of the largest villages in Lago do Junco, which comprises 88 dwellings and several service buildings. The second one corresponds to São Manoel as an institution, or the community of people who live in the village and vicinity. The third usage designates a policy initiative. Since 1989 São Manoel is a settlement project established on a 470 hectare-estate, which benefits 31 long-term occupant peasant families. During three years these families were engaged in a land struggle with a rancher, until the state government adjudicated and purchased part of the land. Pau Santo's designations follow the same rationale. The term refers to a 71-household village in northwestern Lago do Junco; to a community that reaches beyond those spatial boundaries; and to a settlement project carried out by the federal government (INCRA). The latter was installed after the 1985 conflict, and the expropriation of a 1,014 hectare-ranch that was allocated to 50 families.

Except when explicitly noted, I refer to São Manoel and Pau Santo in the broadest sense, which comprises the entire communities, with 542 and 550 inhabitants, and their respective places of residence (Table 3-3). In this analysis, when I use the term

community I include the residents of smaller villages, which are aggregated into the clusters that are centered on and named after the core sites. The core villages are only 12 kilometers apart, with Pau Santo to the west and São Manoel located at the eastern side of a dirt road that crosses the municipality southwest-to-northeast towards Bacabal.

Table 3-3. Households and total population in São Manoel and Pau Santo, 2001

Village	Households	Population
São Manoel	88	379
Estirão	6	25
Lago Queimado	14	65
Centro dos Custódio	8	63
Cluster São Manoel	116	542
Pau Santo	68	320
Pau Ferrado	6	27
São Sebastião	8	41
São Francisco	15	69
São João	17	68
São José	5	25
Cluster Pau Santo	119	550
Total	237	1,092

Source: Socioeconomic survey, 2001

The cluster of villages centered on São Manoel includes residents in Estirão, Lago Queimado, and Centro dos Custódios. The cluster around Pau Santo comprises residents in five other villages: Pau Ferrado, São Sebastião, São Francisco, São João, and São José. The last four are settlement areas formed subsequent to the conflict in Pau Santo. São João and São Francisco are villages in the same INCRA-led settlement project, named Bonanza. São Sebastião and São José are the result of land adjudications.

Contrary to the sparsely inhabited colonization schemes and areas of spontaneous occupation in most of the Amazon, the common pattern of residence in the Mearim is for the dwellings that comprise the villages to be spatially aggregated. These villages, mainly those already existent by the 1950s, are at least partly located on common or public land that is neither registered nor claimed as private property. This land is known as patrimony

(patrimônio), and often belongs to the municipality. Sometimes the patrimônio results from an early donation by a landowner. Larger villages gradually incorporated service buildings and infrastructure that confer upon them the functions and attributes of local centers. Service buildings found in most villages include an elementary school, a chapel, facilities to process rice and manioc, and simple bars and grocery stores. These arrangements are also reproduced in recently established settlement projects. Figures 3-3 and 3-4 show a detailed spatial representation of these two clusters, including the disposition of dwellings, service buildings, and roads in the core villages. Figure 3-5 shows images of villages in Pau Santo and São Manoel clusters.

According to the size of the public area and the customs of the community, residents may be entitled to a backyard area (quintal). Yet, in most cases there is little space to accommodate population growth or the arrival of newcomers. As the village expands and reaches areas beyond the patrimônio, the right to build a house must be negotiated with landowners. A common pattern is the expansion along a road or pathway that connects a core village with smaller nuclei in private landholdings.

In São Manoel, part of the village stands on the public land; a more recent portion comprises houses reconstructed in the settlement area adjacent to the patrimônio. A third portion includes dwelling nuclei on private properties along roads that access the village. Not all families in the settlement project dwell inside the settlement area, and some nonbeneficiaries are presently settled there. In Pau Santo, most families dwell along dirt roads in the original patrimônio, as land expropriation did not compel people to move inside the settlement land. The few households that did so were able to claim backyards larger than the majority, who have access to smaller areas, or none at all.

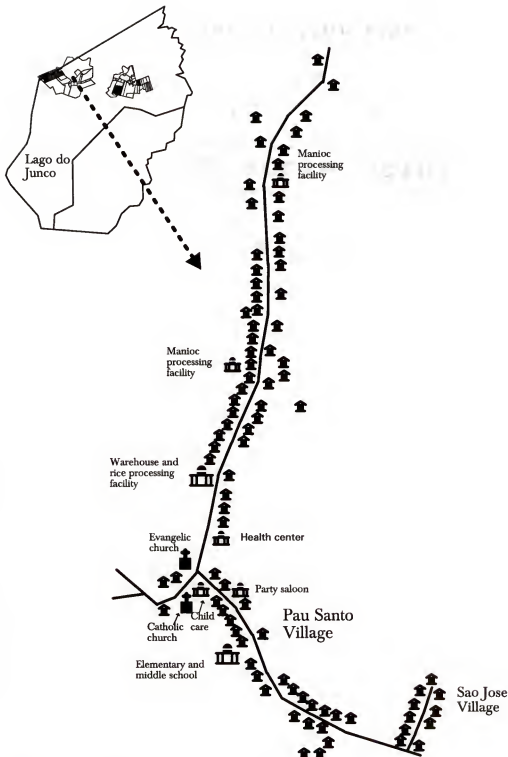


Figure 3-3. Location of dwellings and service buildings in Pau Santo

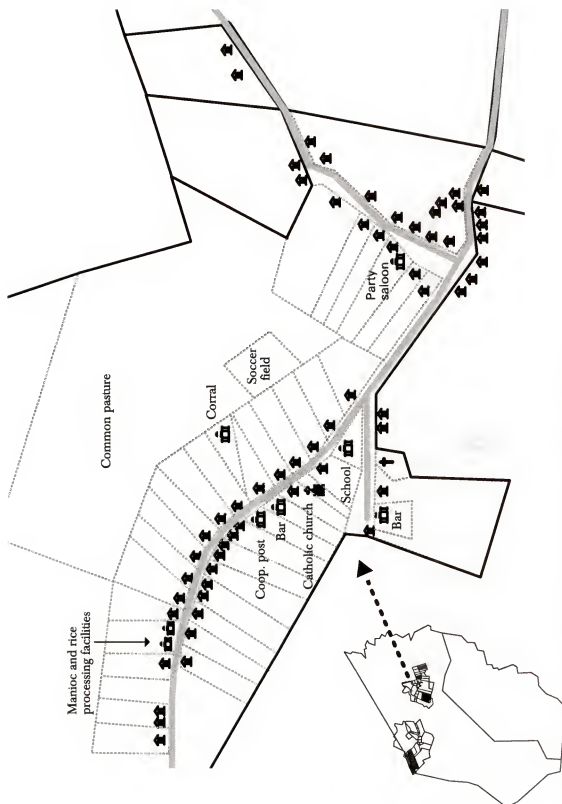


Figure 3-4. Location of dwellings and service buildings in Sao Manoel



Figure 3-5. Villages in the study area. A) São Manoel. B) Centro do Custódio. C) Pau Santo. D) São Sebastião.

The newly formed villages of São Sebastião, São João, São Francisco, and São José present a housing pattern that follows a planned, regular occupation of the available space. Dwellings are regularly spaced at 15-20 meters from each other, and each has the right to a backyard area. Land in these four villages is in collective usufruct, except for three individuals in São Sebastião who split with the group. Conversely, dwellings in the older locations of Pau Ferrado, Lago Queimado, Estirão, and Centro dos Custódios are irregularly distributed.

Since residents of the villages of Pau Santo and São Manoel recovered their land tenure rights, settlement projects in these two (and in the other four smaller villages) maintained common land tenure, on behalf of the members of the then-recently formed associations of producers. However, in 2001, 13 of the 31 settlers in São Manoel decided to claim individual plots, and their land was extracted from the overall area. A similar process had occurred in Pau Santo in 1987, but was short lived and canceled a year later.

At first glance, the two communities may appear similar in terms of household demographics, socioeconomic status, and collective organization. By the time of land expropriation, Pau Santo and São Manoel also had comparable degrees (or rather absence) of basic infrastructure, and similar connections with outsiders. In the aftermaths of the struggles, agricultural land became scarce, contrasting with the abundance of resources in the early period of peasant occupation. By the late 1980s, the two areas were almost entirely covered by pastures in consortium with babassu palms. Despite these similarities, however, the communities were strikingly different in terms of the nature of social relations and internal organization. Next, I introduce these differences.

Introducing Two Contrasting Trajectories

São Manoel is viewed as a “model” community in which social relations and institutions have consolidated alliances that enhanced local livelihoods and improved residents’ welfare. In addition, local leadership played a central role in the operation of institutions linked to higher organizational levels. São Manoel is viewed as a community well-suited for development projects, in which residents have incorporated sustainable development discourses. São Manoel was referential for groups that later pursued similar trajectories. Moreover, leaders of the community successfully transferred to the post-conflict era the abilities they had shown in the process of recovering land rights. Internal struggles did occur, but at a latter stage. These were mainly related to political and ideological disputes and provoked little interference in resource-use.

A different trajectory took place in Pau Santo. Land struggle, despite evoking the bravery and sturdiness of local leadership, was followed by a sequence of post-conflict episodes that accelerated internal disparities. The manner through which social relations developed in Pau Santo became irreconcilable with proper management of social and economic initiatives. Frictions involved personal attributes and leadership disputes among households and groups of households. They were motivated by quarrels over prestige and material conditions. The resolution of conflicts internal to the peasant group was restricted by practices that resembled clashes during their past confrontation against ranchers. Incompetence, rivalry, suspicion and betrayal were frequently heard terms. Local villagers began to be characterized by images of violence, distrust, and lack of managerial skills. According to analytical perspectives based on community organization and participatory development, the post-struggle trajectory in Pau Santo was a failure.

I would argue, however, that approaches based on participation and community mobilization should not be the only ones to address the trajectory of these heterogeneous peasant communities. My portrayal of livelihood, social relations, and people's interactions with the environment in Pau Santo and São Manoel is not intended to attribute values to the process or to deterministically frame those communities according to a linear scale of development or social organization. Rather, the comparative method is used in this study to argue that peasant societies should be examined through the lenses of multiple structuring realities, broadly conceived through the understanding of concurrent processes that operate in various domains. The fact that these communities experienced similar processes, and at the same time took such distinct trajectories attests to the need for refined analyses using multiple approaches. I believe that the analytical framework and theoretical assertions of a grounded political ecology provide a better understanding of the socio-natural transformations in Pau Santo and São Manoel, as well as in peasant societies elsewhere. Because access to land and resources is critical for the livelihood of peasants, I will next analyze land tenure conditions in the two communities.

Land Tenure, Economic Differentiation and Social Stratification

Events related to the dynamics of local landownership in the last half-century undoubtedly contributed much to the present conditions of economic differentiation, social stratification, and class formation in the area. In Table 3-4, I summarize the current land tenure status of resource-users in Pau Santo and São Manoel.

Table 3-4 classifies resource-users according to three broad land tenure categories. The first one, private landowners, is further subdivided into small-, medium-, and large-holders. For the purpose of this classification, smallholders own more than one but less than 20 hectares; medium-holders own between 20 and 200 hectares; and

large-holders own more than that amount of land. The second category, referred to here as settlers (*assentados*), are the beneficiaries of agrarian-reform initiatives. Although most settlers initially had access only to common land, some of them have been acquiring additional private property. Those in the third category, landless families, own no land, or areas smaller than one hectare around their houses.

Table 3-4. Land tenure status of resource-users in Pau Santo and São Manoel, 2001

Land tenure status		São Manoel		Pau Santo		Total	
		hholds	ha	hholds	ha	hholds	ha
Private landowners (only)							
Small	1-20 ha	16	138	7	74	23	212
Medium	20.1-200 ha	8	481	6	618	14	1,099
Large	> 200 ha	1	209	-	-	1	209
Total private land		25	828	13	692	38	1,520
		21%		11%		16%	
Common property in settlement land			470		2,024		2,494
			33%		73%		59%
Only common property		21		75		96	
Settlers with additional land (> 1ha)		10	142	2	43	12	185
Total settlers		31	612	77	2,067	108	2,679
		26%		65%		46%	
Landless		62		29		91	
		53%		24%		38%	
Total		118	1,440	119	2,759	237	4,199

Source: Socioeconomic survey, 2001

Table 3-4 shows that total area comprised by Pau Santo is almost twice as large than São Manoel's. The combined area of the clusters is 4,199 hectares, or about 7% of the municipality's territory. Almost three-fourths (73.4%) of the area of landholdings in Pau Santo is common property (settlement projects), compared to less than one-third in São Manoel (32.6%). In both clusters, a few private properties belong to nonresidents (3 medium-holders in Pau Santo, and 6 smallholders in São Manoel). In São Manoel, a 50-hectare property was acquired in 2001 by COPPALJ, the Agroextractive Cooperative. Only one of the 237 resource-users in these two clusters owns more than 200 hectares:

José Nogueira, who agreed to be interviewed in the summer of 2000. Born in Pedreiras from Cearense parents, Nogueira arrived in São Manoel in 1945, joining other family members who previously settled nearby. Nogueira passed away a few months before my next visit in São Manoel, in 2001. Soon, the largest private landholding remaining in the area will no longer exist as such. Half of the property will be transferred to Madalena, who is Nogueira's second wife, the other half split among the four children of his first marriage, none of whom live in São Manoel.

Low concentration of landownership, though, was not a pattern in the region. After the establishment of peasant villages, concentration trends began in the 1960s, and by the early-1980s, just three individuals held almost 75% of the land in the two clusters. A decade later, however, social struggle forced the expropriation of these landowners by agrarian reform initiatives, and the land was redistributed to peasants who thereby reacquired tenure rights. Hence, the study of socioeconomic transformations in Lago do Junco encompasses a sequence of processes that, on the one hand, has led to land accumulation, and on the other hand resulted in the subsequent dismantling of concentration of landownership. These processes and events will be addressed next.

Socioeconomic Trajectories and Transformations in Pau Santo and São Manoel

Present-day socioeconomic configurations in Pau Santo and São Manoel are informed by the integration of processes and events that continuously and dynamically transform society. Processes that diachronically modify the social system are coupled with transformations in biophysical configurations, provoking complex and interrelated socio-natural alterations, which are diverse for each ensemble. In every society, the occurrence of major transformative processes alters socioeconomic configurations and sets novel standards for the continuity of renewed socio-natural ensembles.

In their analysis of change and resilience in complex systems, Holling and Gunderson (2002:32-49) offer the metaphor of an adaptive cycle that includes the phases of exploitation, conservation, release, and reorganization, and claim that the representation can be applied to social systems as well. The adaptive cycle heuristics can be, in my opinion, integrated with the grounded political ecology framework proposed in previous chapters. The integration would consist of assessing each phase of the adaptive cycle as a different moment (α , β , and so forth) for a particular socio-natural ensemble, with the passages between phases being mediated by multiple processes and domains. Although I would be cautious in arguing for the universal application of the cycle according to a rigid sequence of phases, and contend that blurred boundaries may very well exist between phases, the metaphor is useful to provide a periodization in the analysis of socioeconomic transformations in Lago do Junco. Hence, the depth of understanding and comprehensiveness provided by the grounded political ecology framework increases the explanatory power of the adaptive cycle. With the integration of explanatory domains provided by the former, the latter gains greater sophistication in the analysis of processes that interfere in the passages between phases. Therefore, in line with a four-phase cycle, I have classified historical events and processes taking place in Lago do Junco into four periods, named according to their predominant feature. These periods are the formation of the peasantry (exploitation); economic differentiation; stratification and class struggle (release); and the transformation of the peasantry (reorganization). In what follows, I examine major socioeconomic processes that activated transformations in each of these periods. Then, Chapter 4 examines the human interventions in the biophysical environment that are coupled with these transformations.

Peasantry Formation (1920s to the Mid-1950s)

The four major processes in the Mearim Valley that contributed to the formation of one of the largest peasantries in Brazil were the expansion of freed slaves and their descendents beyond estates they previously worked; the incorporation of detribalized Amerindians, mainly from the Guajajara culture; the arrival of settlers from southern areas of the state, as several of Lago do Junco's pioneers; and the massive westward movement of northeastern migrants from Ceará and Piauí.⁷ While up to the 1940s Pau Santo and São Manoel were mainly occupied by Maranhenses from Pedreiras or Ipixuna (São Luis Gonzaga) with a mixed ethnicity that reflected the combination of these processes, most of the settlers who arrived in the 1950s and 1960s were northeastern migrants coming straight from the states of Ceará and Piauí.

Despite their seemingly religious names, the villages of Pau Santo and São Manoel were named after landmark trees found by pioneer settlers of each site.⁸ As in the town of Lago do Junco, non-indigenous settlers first arrived in the 1920s with the intent to establish centros and to crop on lands where the villages are presently located. The original indigenous inhabitants from the Canela and Tenetehara cultures had already headed south, towards Barra do Corda and Grajaú. Pau Santo and São Manoel were not far from lands in São Luis Gonzaga, where since the mid-19th century had operated slave-work based cotton and sugarcane estates. Indeed, several of the areas' initial settlers were freed slaves from those estates (or their descendents) in search of unoccupied land.

⁷ Lago (1976:8) documents that northeastern migrants in search of fertile, unoccupied lands for agriculture began to reach the Mearim Valley in the 1870s.

⁸ Pau santo, a hardwood known in the logging industry by the trade name of Brazilian ebony, is the vernacular name for *Kielmeyera variabilis*, a tree of the Guttiferae family.

It is likely that the first ones to crop near lands in what are today the villages of Pau Santo and São Manoel were anonymous squatters who did not consolidate their settlement, moving further west to settle on frontier areas. This was a common trend in the area, as attested by Doni Arruda when he recounted his arrival to Lagoa da Lata in the 1930s, and by Milton Monteiro, one of Pau Santo oldest residents: -

I was the one who tamed Lagoa da Lata. When we arrived in 1936, there were seven or eight residents [...] but then everybody moved to Bela Vista, beyond Bacabal. Some of them sold us their house, the mortar, their little things. Some others even left their things, saying: hey sister (cumadre), take care of my house. If I am back, good. If not...(Doni Arruda)

I don't know who was the first one in Pau Santo. I know that the first one to settle in was José Rodrigues, who in 1922 purchased a roça with a hut inside. I don't know who cleared the land and made the hut, but I know Rodrigues was the one who got here and bought them. (Milton Monteiro)

Pioneer residents in Pau Santo and São Manoel are said to be José Rodrigues, who settled Pau Santo in 1922, three years before Lago do Junco's founding, and Antonio Bernardo dos Santos, who settled São Manoel in 1926. Their contrasting trajectories illustrate the diversity of options facing the livelihood of people in the area. Rodrigues was able to consolidate his land claim, accumulate assets, and establish private property in Pau Santo. These lands are still owned by his family. In contrast, Bernardo dos Santos left São Manoel in the 1950s with no property, and none of his descendents remain in the village. Remarkably, the trajectories of José Rodrigues and Bernardo dos Santos were exceptions to predominant trends in Pau Santo and São Manoel. In processes that profoundly influenced the two communities, most of Pau Santo's initial residents left, while the majority of São Manoel's old dwellers remained upon land privatization of the 1960s. The divergent trajectories of the pioneers serve as an entry point to analyze socioeconomic configurations since the establishment of these communities.

Old residents' narratives indicate that, by the early 1950s, Pau Santo, São Manoel, and other villages in the region were at least as populated as they are today, perhaps even larger, as attested by the quote below.

In 1947 we arrived here and it was already a village of at least 150 families. There was not a lot of primary forest (*mata*), but a lot of young fallow (*capoeiruçu do primeiro fogo*). (Milton Monteiro)

In this period of resource abundance, landownership was practically absent in the region, except in the former slave-based estates of the Mearim. Pasture was still incipient. Given resource abundance and predominance of shifting-cultivation, most resource-users never envisioned the need for private property. To set the boundaries controlled by each *assituante* (the initial settler of a *centro*), people roughly calculated the mid-point between two *centros* along a cleared pathway (*variante*), and used a marker of some sort. Despite the fact that rough landmarks established differential entitlement of pioneer families, the practices employed throughout the years for the use of local resources did little to differentiate among peasant producers in this period. Accumulation through commercial and processing operations was still limited among villagers, as Hosano Gomes and others in the cities of Pedreiras and São Luis Gonzaga controlled merchant transactions. Producers freely cropped on lands considered as a frontier zone until the mid-1950s. Their *roças* were often established on 15-20 year fallow schedules, and cultivated on a household basis, even though exchange labor and other forms of cooperation were observed. The following narrative by Milton, who is a community leader in Pau Santo, contextualizes those early conditions:

At that time you had to work in common labor. There was nobody to prevent people's work, wherever it was. At that time people raised cattle, goats, but up to 1958 there wasn't much sale of meat. When someone slaughtered a pig or a goat, they shared pieces with the others. And everyone did the same. To me, that was not poverty. There was more abundance. If you had some, you gave to others, and

if the others had some, they would give it to you. And it was exchange, not sale. If you had to buy supplies in the stores, it was done annually. If you purchased this December, you would pay in the following December, with no interest. My father used to get supplies with Hosano Gomes in Lago do Junco, and to pay with the next harvest. Then, nobody was concerned. Maize and rice were even left to ripen in the fields, and there was a lot of abundance. People say that the objects, furniture, were not as nice as today: indeed they were not, but there was abundance. And is not fair to say that people walked around scruffy. They got well dressed, if needed. They had ok clothes for every single occasion. There was less money, but there was some, and it always worked out. (Milton Monteiro)

Nogueira, the landowner from São Manoel, expressed similar perceptions of landownership, poverty, prosperity, and on the changes in people's aspirations. Taken together, these two narratives illustrate a period where social hierarchies were not based on economic accumulation and political power, and social institutions were intertwined with systems of resource-use that contributed to level household livelihoods.

When we got here in 1945 there was no such thing as [private] land. Everything was in common. People would say 'this thing is mine,' but just for the sake of saying it. That wasn't to mean that I owned the land, so people who cropped there would pay rent. That did not exist. In the early times everybody lived well. Everybody was poor, but lived well. There was a lot of abundance. Today people say that they live well, but everyone is struggling. I recall that in the early times we used to eat over a mat, on the floor. Others slaughtered a pig, giving pieces to one and another, or lent it. People got game, and that was ok. Not today. Everything changed. Everyone wants to have the better chair, to own a TV. Today, the poor want everything that the wealthy ones have. (José Nogueira)

Transformation in social relations intensified with the greater presence of northeastern migrants. Particularly after the intense droughts of the early 1950s, migrant families from Ceará and Piauí arrived in large numbers to the Mearim. Table 3-5 shows that over 60% of Pau Santo and São Manoel residents who are older than 50 years of age were born in these two states.

The occupation of Pau Santo and São Manoel was marked by cultural collisions between Maranhenses and Nordestinos, to the benefit of the latter, exemplifying a veiled problem of racial and cultural integration in Brazil. Cultural differences between groups

was expressed in the work of geographer Orlando Valverde when describing inhabitants of the Mearim, with terms that clearly denoted prejudice against the early inhabitants:

The Cearense works hard. He has initiative, disposition to open doors for a better future to his family, regardless of the cost. It is a patriarchy, but everybody works: men, women, and children.... Maranhão's caboclo is a loser, defeated by economic dependency, the legacy of slavery, and his own indolence. His social role is almost limited to mere reproduction. Women start working early, however. At 6 or 7 years old they begin to crack babassu to buy clothes for themselves. But at 16 or 17 most become prostitutes. (Valverde 1957:32, my translation)

Table 3-5. Origin of older residents in Pau Santo and São Manoel

	São Manoel		Pau Santo		Total	
	people	%	people	%	people	%
Origin of residents 50 years & older						
Lago do Junco	6	11.3	7	13.0	13	12.2
Other cities in the Mearim	11	20.8	10	18.5	21	19.6
Other cities in Maranhão	3	5.7	3	5.6	6	5.6
Ceará	29	54.7	23	42.6	52	48.6
Piauí	4	7.5	11	20.3	15	14.0
Total	53	100.0	54	100.0	107	100.0

Source: Socioeconomic survey, 2001

Lifestyle and cultural patterns introduced by Cearenses did not favor integration, particularly in São Manoel, and contrasted with those of Maranhão's caboclos. Cearense migrants found attractive conditions to develop economic strategies they learned in their previous environment. Compared to local fishermen-hunter-extractive-horticulturalists, their livelihood strategies used to be more constrained, and associated with intense agricultural work. They frequently used pejorative terms when referring to local families, perceiving them as lazy and with no expectations of future improvement. The arrival of Cearenses in São Manoel was announced by comments such as the one reproduced below by Genário, a migrant, whose brother in law preceded him in 1953:

My brother in law told me that in Maranhão we can make a living, that there is plenty of production, the harvest is good, and the Maranhenses go away when Cearenses arrive. They seem to be afraid of us. They move to Pará and even leave their maize and manioc in the field. They run away because they think Cearenses

are frightening: wherever they go, they are clever and do any labor well, and they laugh at the way Maranhenses work. (Genário Lima)

The peasantry formed in Pau Santo and São Manoel resulted from the encounter of these heterogeneous social groups. On the one hand, the long-settled Maranhenses, with their heritage and ethnicity strongly marked by the slave economy, emerged from the disintegration of Maranhão's plantations. On the other hand, those forced to leave the decadent Northeastern plantations that were unable to keep their reserves of labor. Cultural differences between these groups were therefore an early component of social stratification in Pau Santo and São Manoel, a factor that was stronger in the latter. Unable to cope with such differences, a number of the early settlers left for more distant frontier lands. A few remained, and were joined by others who acquiesced to their submission.

However, origin or ethnicity alone does not explain economic differentiation. This is attested by the impoverished and powerless households with northeastern background that presently live in these and in other communities. Yet, although diluted in present day social configurations, the origin and ethnicity of resource-users has deeply influenced the human relations in Pau Santo and São Manoel, critically contributing to the differential access to policy and financial instruments that became available in the next period.

Economic Differentiation (Mid-1950s to Mid-1970s)

By the late 1950s, the peak period of rice production in the Mearim, commercial operations within villages had acquired greater expression. The extraction of agricultural commercial surpluses, once directly channeled to merchants in the towns, now gained enough leeway to allow additional links in the trading chain. Better-off peasants installed commercial stores, and became middlemen themselves, with financial support of established merchants. These middlemen constrained the accumulation of surpluses by

other producers through various mechanisms. Common practices included advanced credit to be converted into rice payments,⁹ lower prices paid at the harvest, and higher prices for staples and household consumer goods. In addition, these intermediaries had exclusive rights to purchase babassu, and to process rice, manioc, and maize.¹⁰

In Pau Santo, a nephew of José Rodrigues, the pioneer, began to accumulate wealth through merchant operations. Since the 1950s he performed roles similar to coronel Hosano in Lago do Junco. Also known as Augusto Cego (because he was blind) he maintained a large store that sold food, supplies, medicines, and clothes. He purchased the local production of maize, rice and cotton, and also owned rice and manioc mills. Up to the 1960s, Augusto Cego was considered the owner, or dono of Pau Santo:

Pau Santo's coronel, Augusto Rodrigues, used to live right there, where our chapel now stands. He owned large stores, he traded big, had a lot of land, cattle. They used to say that if he ordered people to catch dung with their mouth, everyone would do it. (Antonio Batista)

Along with land privatization, commercial operations were the main engine of economic differentiation and the concentration of wealth in the region. With no means to pay debts, and attracted by an open westward frontier, an alternative for dispossessed families was to negotiate tenure rights with these middlemen, and move out. Indeed, the 1960s marked the integration of Maranhão's lands into the market. Such integration

⁹ January to March is the more stressful period for peasants in the Mearim. Their rice supply is exhausted given previous obligations to the middleman. Engagement in wage labor conflicts with the need to cultivate their fields. In addition, in February begins the period of lowest production of babassu. Middlemen advance payment for rice at a 2:1 or 3:1 ratio, to be paid with the harvest. When borrowing cash, even lower values are paid for peasants' rice. A significant part of the harvest is thus used for these payments. For a detailed description of transactions in the rice commercial circuit in Maranhão, see Musumeci (1988:264-286)

¹⁰ Manioc flour is produced at manual or diesel powered *casas-de-farinha*, under a 5 to 10% fee. Rice mills (*piladores de arroz*) charge 1 kg of rice per 30 kg of paddy, plus by-products (used as swine feed). In addition, mill owners return only 21 kg of rice, despite 23 to 24 kg result after processing 30 kg of paddy.

subsequently led to the material benefits of those able to claim private property, and to land brokers engaged in the privatization business. In most of the Mearim this was expressed through demarcation, and sale to better-off buyers, of lands that, although already settled, were considered "state land."

We used to live here up to the 1960s, when this sale of land began. It was not for the workers; it was for the better off. That was when people with no knowledge began to get out; they began to leave. (Milton Monteiro)

Two individuals were directly involved in most of the area's land demarcation in the early 1960s, when Lago do Junco was under the administration of São Luis Gonzaga. Vicente Bezerra, then vice-mayor, moved to Pau Santo in 1952. His wife taught in the local elementary school. Antonio Baia was a resident of Cajazeiras, a neighboring village. These individuals had links with insiders in the state apparatus of land privatization, implemented to obtain revenues through land taxation. Bezerra and Baia formed a business to survey land and provide owners-to-be with maps for cadastral purposes. As noted, by that time Pau Santo and São Manoel were villages of considerable size and population. Yet, there was little differentiation in terms of land entitlements for these dwellers. The idea of buying and registering land in someone's name was viewed with skepticism by most of local residents, even though the actual price to be paid was considered low. Land prices corresponded mainly to the cost of the surveying service. In addition, these brokers had their priority targets as they went about this business:

They knew who were the better-off: those who had a manioc mill, or other assets. They went straight to them announcing what they were doing, offering their service. They said they were distributing land, and it was cheap. With 20 contos you could mark 400 hectares. You paid them and that was it, you owned that land. Later you would get a map, and some would get the title. They claimed that everyone who wanted land could buy it. But it was not fair for those with no money. (Antonio Batista)

Purchase and demarcation did not always follow the contours or rights established during the initial settlement. Several early settlers had already left, “frightened” as they were by Cearenses, or upon small compensations following the sale of a simple house and eventual land improvements. Except for a few cases, there was no contestation or dispute. Owners-to-be simply led surveyors along boundaries that they (the landowners) had basically made-up. In general, properties ranged between 100 and 200 hectares.

Siblings or other relatives often held lands with limiting boundaries:

In 1962 this land was all forest, good to crop (mato de fazer roça). Then everyone set his land, his boundaries. We bought 516 hectares. Pedro bought mine, his, Didi's, and our father's. That was the way land was distributed. (Doni Arruda)

Very few people--perhaps 12 to 15 in each location--ended up registering and purchasing “state” land. As Table 3-6 shows for Pau Santo, most of them were from Ceará and Piauí. The table also shows property turnover around Pau Santo since this time. It portrays the trajectory of those who first claimed private land, indicating whether they retained their original area, expanded their property, or sold it to others.

Table 3-6. Landowners and property turnover, Pau Santo cluster (1960-2000)

1960	1970		1975	1980	1985	1990	1995
Jorge (PI) 100 ha	Wilson Maciel (São Luis)			Manoel Bezerra	INCRA Pau Santo		
Isaac (PI) 100 ha							
Antonio Francisco 200 ha							
Raimundo Nazario (PI) 100 ha							
Francisco Fernandes de Assis (PI) 170 ha							
Vicente Bezerra 200 ha	J. Crente	N. Silveira	A.Procópio J. Buchudo				
Augusto Rodrigues (MA/CE)							
Fco. de Assis (PI) 200ha	Monteiro				Nilson Silveira	S. Fco.	
Herculano Moreira (PI) 278 ha					Nilson Silveira	S. Sebastião	
Evangélio Cardoso (CE) 190 ha							
Antonio Procópio (185 ha)						P. Ferrado	
Vicente Ferreira (CE)							
José Rodrigues (MA)							
Cecílio Gomes							

Land privatization and the possession of land titles expanded the opportunities for better-off peasants to consolidate their economic differentiation. Opportunities included the increase in commercial activities, and resources provided by the state for agricultural “modernization”(which in fact meant pasture conversion). Landed resource-users gained access to rural credit, and endorsed credit operations of landless people in exchange for economic compensation and political support. The accumulation of wealth by this group of producers was to a large extent a direct function of their social relations and relations of production with other villagers. It was with land privatization that Adelino, a Cearense who settled in Lago Queimado in 1942, began to expand his economic operations.

He [Adelino] is a hardworking man. He explored and tamed Lago Queimado, those foothills. Everything he did was with the sickle, weeding and catching rice. He dressed in old, patched pants. When he began to raise cattle, he was always covered with shit. He used to be a worker, a guy good for roça. (Doni Arruda)

Although others did not start such practices until much later, landowners such as Augusto Rodrigues in Pau Santo, and Adelino Barbosa in São Manoel increasingly appropriated peasant resources by requesting unpaid labor obligations, and moreover, by gradually extracting rent from villagers who cropped in “their” land. Rental agreements were paid with part of the harvest, often rice. Informal rental contracts stipulated that land concession was the only obligation for landowners. Renters had to pay an average of two alqueires per linha, the equivalent to 180 kg of rice per hectare, or 5 to 20% of the harvest.¹¹ Perennial crops were severely restricted (they were seldom planted anyway, except for a few fruit trees or banana groves), but the inter-cropped maize, beans, and manioc were usually free of rent. Rent was sometimes flexible, and changed during a

¹¹ The alqueire/linha (1 alqueire = 30 kg of rice; 1 linha = 0.33 hectares) still is the most common unit to measure rent. According to my personal observations, peasants in the Mearim consider the charges of 1, 2, and 3 alqueires/ linha as respectively fair, acceptable, and a violation of social rules.

bad-harvest year or when unexpected crisis affected a household. As long as certain reciprocal obligations were maintained, there was little opposition to paying rent. For those who did not agree with the new arrangements, there remained the alternative to leave. And many did so, especially in Pau Santo, where only three of the families that lived in the village in the pre-1950s remain up to the present day.

Registering property, however, did not automatically grant better-off peasants with transformed social roles. Some of them, such as Antonio Soares and Joaquim Araújo (São Manoel), and Evangélio Cardoso and Antonio Procópio (Pau Santo), remained within the boundaries of their original holdings. They did not engage in commercial operations, and had no intentions to extract rent. Others, such as Adelino Barbosa, adopted an expansionist strategy and actively engaged in capitalist undertakings. They assumed the condition and identity of ranchers. Still others, such as Herculano Moreira and Francisco Assis ended up selling their land and moved to the city or to distant areas, reproducing a common peasant strategy, this time with the benefit of a cash payment.

Land transactions in São Manoel remained internal to the village. Holdings were sold to or appropriated by Adelino Barbosa, and to a lesser extent by José Nogueira. Conversely, land transactions in Pau Santo involved absentee owners, outsiders who, in addition to converting land to pasture, had little social interaction with the community. The “insider” who could have accumulated Pau Santo’s land was Augusto Rodrigues, but family reasons prevented his expansionist trajectory. Augusto’s land and overall wealth did not survive the erratic life of Adroaldo, his only natural son, who lost everything due to excessive drinking and womanizing. Adroaldo’s fate is narrated by a senior woman:

Augusto had one son of his own, who was studying medicine in São Luís. But he quit, and then the only things he cared about were women and drinking in

cabarets ('se danou na raparigada e em bebedeira'). He was a coward; he broke his father, finished everything. Truckloads of cotton and rice were sent to Bacabal to pay his debts. Can you believe that he ended up cracking babassu with a prostitute ('rapariga')? (Maria José Pereira)

As Table 3-6 shows, landholdings in Pau Santo were gradually sold to Wilson Maciel, a rancher from the state capital who subsequently passed the entire area to Manoel Bezerra Neto, who had recently arrived from Ceará. Others in the vicinity sold their holdings to Nilson Silveira, Maciel's brother-in-law, who lived in Caxias. These two fazendeiros began to purchase land in 1969-1970. They gradually increased landholdings in Pau Santo and vicinities, up to more than 1,000 hectares each a decade later.

By that time, as peasant tenure rights dwindled, land was no longer a common good; it became property, *terra de dono* (owner's land). In effect, the mid-1970s social configurations in Pau Santo and São Manoel included three well-defined categories of resource-users: dispossessed peasants; landed peasants; and large-holders who had or were in the process of converting their land to pasture. Peasants in the first category perceived economic differences between them and the landed, better-off peasants. Yet, they still acknowledged that those in the second group kept livelihood features that were similar to those of their own. Conversely, dispossessed peasants perceived ranchers not only as economically distinct, but also as forming another social segment.

Severe economic differentiation occurred from the mid-1950s to the mid-1970s among resource-users that--as seen in the previous section--had a mixed cultural background. Critical to this differentiation were the intensification of market circuits, bolstered by state-supported land privatization. Rather than land adjudication and recognition of peasant tenure rights, the omission of the state favored illegal land appropriation (*grilagem*) and, in the case of Pau Santo, the arrival of outsiders. Yet, as is

seen in developments of the next period, commercial accumulation and land privatization were not sufficient factors to transform growing economic differentiation into a rather distinct process of social stratification and class formation. The conversion of agricultural lands to pasture was critical in this regard, as it changed the social function of natural resources. Such conversion has generated an unprecedented wave of violence and expropriation in the Mearim. In certain areas, it later provoked peasant resistance and conflict, as was the case in Pau Santo and São Manoel.

Social Differentiation and Class Struggle (Mid-1970s to Late 1980s)

By the second half of the 1970s peasants were increasingly prevented to access natural resources, and had ultimately lost their tenure rights. The “Land Law” (Lei de Terras) approved in 1969 in Maranhão state, was in accordance with development policies of Brazil’s military regime. Such policies included fiscal incentives and subsidies, that transformed social relations and relations of production in rural Maranhão.

State action in the form of subsidized credit and fiscal incentives to ranchers in the 1970s fomented a massive process of pasture conversion to replace rice fields and fallowed lands. Amaral Filho (1990:233) noted that 77 subsidized livestock projects in more than one million hectares were introduced in Maranhão. This was accomplished with financial support of SUDAM (Superintendência para o Desenvolvimento da Amazônia) and SUDENE (Superintendência para o Desenvolvimento do Nordeste), the two regional development agencies. Between 1975 and 1985 the area converted to pasture in Maranhão more than doubled, from 12,182 km² to 27,903 km², whereas the area for annual agriculture increased from 10,140 km² to just 12,181 km². In the same period, cattle herd in Maranhão jumped from 1.8 million to 3.2 million, while rice production decreased from 894,000 tons to 779,000 tons (IBGE 1979, 1990).

Locally, as with dozens of other villages in the Mearim, Pau Santo and São Manoel became surrounded by pasture and cattle. Particularly for these two communities, it was land-use and management practices adopted by Adelino Barbosa, Nilson Silveira, and Wilson Maciel--and later by Manoel Bezerra--that curtailed livelihood opportunities. Below, the narratives of José Leopoldo and Milton summarize the transformation.

Many people from my dad's generation said that the land was free, that there was no need to demarcate it because it was the land of Princess Izabel [who signed the law ending slavery in Brazil]. They told us that they would mark and fence land, but nothing would change, land would still be free and people could keep working on it. But we were deceived. After land enclosure, we kept planting roças, but then they began to spread pasture grass, each field was transformed to pasture. After ten years, in the early 1970s, we began to feel that access to land was more and more difficult for the poor. All land around villages was transformed into pasture, and land for roça was only available far away. (José Leopoldo)

I myself have worked for them, cropping, paying rent. We ate all the forest, the palms, and then they put in pasture. We thought we were doing the right thing, but then we realized that we ruined our future. There was no place to work anymore. (Milton Monteiro)

For some peasants, rent extraction was even acceptable, as long as land was abundant and resources provided enough for the social and economic reproduction of the group. Apparently, at that moment it made little difference to them whether in previous times land was open access or controlled by a landowner to whom they had to pay rent.

In my opinion, Nilson was a very good person. During five years he signed for me to get bank credit. He was not an angry person, even with all these struggles for his land. There was no fight, he was an agreeable person ... Wilson Maciel was wealthier, he did not want to get close, to mix with poor people. Unlike Nilson, who was friendly with everyone. (José Brito)

As discussed in Chapter 7, not all Lago do Junco's peasants shared the same opinion. Moreover, this perception was radically transformed when differences in lifestyle and socioeconomic status related to ranching were exacerbated by a sense of relative deprivation resulting from the scarcity of land for rice production, the exhaustion

of the open frontier, and the restriction of access rights to babassu stands. In addition, such perceptions began to be transformed with the assistance of the network of social actors linked to the religious-base communities and the Catholic Church.

In fact, 1980 marked the first land struggle in the Mearim. The conflict took place on lands owned by Wilson Maciel in Centro do José Machado, 10 kilometers east of Pau Santo.¹² Local residents reacted against pasture expansion, babassu eradication, and tough management practices. While everywhere else peasants still accepted subordination, in José Machado they resisted for three years until the rancher agreed to sell the land to the Franciscan order. The order installed an unofficial settlement project in the land. In addition, the Franciscan friars installed a center for the education of young missionaries in José Machado. Initiatives of these friars deeply influenced rural Lago do Junco. Their legal, moral, and material support was decisive to solve the struggle in José Machado, having also inspired other communities' uprising. Moreover, they devised a tenure system based on the common property of land managed by associations of producers. This type of institution and land tenure system were later reproduced in several other areas in Bacabal's diocese, including Pau Santo and São Manoel.

After conceding land in José Machado, Maciel sold his property in Pau Santo to Manoel Bezerra, who wanted to convert the land entirely to pasture. A struggle began when Bezerra was about to form the last 120 hectares of pasture, and refused to allow people to crop in that land. The nature of the struggle that led to the recovery of peasant tenure rights over Pau Santo can be appreciated through the narratives below:

¹² A common transaction characterizing the last resort for landowners threatened by peasant struggles in Maranhão is the transfer of their property to individuals known by their use of violence. At the onset of the struggle in José Machado, Wilson Maciel transferred his property to João Aguiar.

Each landowner has a particular regime, and Bezerra come with a regime distinct from the others. He was not willing to give land to anybody. People here used to raise pigs, and he used harsh words saying: tell those horny people from Pau Santo that if they don't hold those pigs I will kill them all. This made two people react, because they were working for him, clearing his pastures. These two asked to use an area that was still good for roça, and he denied it. (Milton Monteiro)

We argued that the forest fallow there was too good for him to hire contractors and clear it. We stopped them because it was land to plant roça. Those 400 linhas [120 hectares] were cleared long ago, but they were good again. (José Brito)

Then we gathered everyone here, some 50 families. We set our roças, some pieces here and there, without his consent. In 1985 we were stopped from planting, but no one remained without roça in that year. We forced it, even though he didn't like it. Then the struggle arose... He wanted to make an agreement for us to keep only 400 linhas, but what would it do for 50 families? Therefore we held firm: it was all or nothing. (Milton Monteiro)

Despite differences in the origin and social relations maintained by landowners, conditions in Pau Santo and São Manoel resulted in conflicts with similar characteristics. As noted, Maciel and Bezerra were outsiders who purchased land in Pau Santo around 1970, while Adelino had arrived in Lago Queimado almost three decades earlier. Adelino took advantage of land privatization; successively incorporating areas worked by peasants in Centro do Aguiar, Lago Queimado, and São Manoel. With no reasons to distrust a community member, São Manoel residents initially supported Adelino, even elected him as city commissioner in 1968. Gradually, the land was enclosed and the better-off peasant became a rancher living in Bacabal.

By the late 1970s, Adelino had undergone profound changes in his identity, lifestyle, and economic operations. When road permitted, he rode his pick-up truck to Centro do Aguiar, where his brother was a merchant. In Aguiar he maintained one of his two wives (the official one living in the city), and based operations while in the countryside. Besides the land in Lago do Junco, Adelino owned other properties in the Mearim and Grajaú, totaling some 3,300 hectares.

Preceded by events in José Machado and Pau Santo, the struggle in São Manoel began after Adelino imposed greater restrictions on people's engagement in babassu extraction. On the one hand, he eradicated productive palms to optimize pasture formation. On the other hand, unrestricted access to babassu was replaced by contractual arrangements. Individuals now paid rent for exclusive rights to collect and trade in certain areas. Such contracts usually complemented the revenue of ranch managers or cowboys (*vaqueiros*). Contractors hired people to gather fruits, and allowed a limited number of women to extract kernels. They also sold the babassu husk, used for charcoal production. Collectors were paid by productivity, and were therefore encouraged to cut down entire bunches instead of waiting for the natural fall of fruits. Reaction or compliance to these contracts served to distinguish between two groups that had emerged: those in favor, and those against the ranchers' mandate. Reacting against such arrangements, the active participation of women in São Manoel--and later in several other communities--was key for future claims and conflicts on behalf of their tenure and access rights.

Once with little land for agriculture, São Manoel residents heavily relied on the sale of babassu kernels for survival. The conflict began in 1986, when Adelino granted commercial exploitation of babassu to Maria Simeão, a resident of Lago Queimado. The peak of the conflict was in August, when Adelino ordered gunmen and the state police to pull down the entire village using a truck with a steel cable. Peasant families were displaced and dispersed for more than a year. People were hiding in the forested hilltops and in neighboring villages, while collectively planning how to regain tenure rights.

They recovered tenure rights in 1987, when the state government purchased part of the land, while another portion was adjudicated as public property. Adelino was paid

for improvements made in the total area of 470 hectares, and the 31 families rebuilt their houses destroyed during the conflict. Adelino kept his land in Centro do Aguiar for another seven years, but sold that ranch in 1994 to an investor from Piauí. This is Fazenda Alegria, which in 2001 was site of the last land conflict between ranchers and peasants in Lago do Junco. Despite these achievements, the last decade presented new challenges to the livelihood of residents in Pau Santo and São Manoel, as struggles of a distinct nature currently transform the internally differentiated peasant society.

Peasantry Transformation (1990s and Beyond)

Rural workers are not united. We were not united at that time. We were worried, and when a guy is worried he doesn't want to be alone [quando o cabra tá com medo ele não quer tá só]. Then, when the struggle with the powerful ones was over, there are issues among ourselves, rural workers, and we didn't seek a way out of them. (Milton Monteiro)

During the time of the strike, we did things in such a way that we got together, we planned, we discussed things, and turned these discussions into action. But soon after, this all disappeared. (José Brito)

The above quotes synthesize the perceived loss in community mobilization and growing internal divergences in the aftermaths of land conflict in Pau Santo. Indeed, although struggles in Pau Santo and São Manoel began in 1985 and 1986, it took a few years to complete the transfer of tenure rights on behalf of peasant families. Now treated as settlers, the delay was reason enough for a good share of the organizational problems experienced by these communities. ITERMA officially started the settlement project in São Manoel only in 1990. It took a week-long occupation of INCRA's building in São Luis by Pau Santo settlers for the launching of the settlement project in 1991.

Yet, achievements in Pau Santo and São Manoel were followed by a succession of events that considerably reduced the hegemony of ranchers, concentration of landownership, and economic inequalities in Lago do Junco. A handful of properties

larger than 1,000 hectares still remained (Table 3-1), but land conflicts forced government agencies to intervene and partially reverse--at least in Lago do Junco--trends that had prevailed since the 1960s. Near Pau Santo, part of the land controlled by Nilson Silveira was adjudicated and transferred to peasants in São Sebastião. INCRA expropriated another part to install the Bonanza settlement project in São João and São Francisco villages. The state government is currently adjudicating the remaining area, where the village of São José is located. Near São Manoel, peasants recovered lands in Aparecida and Sítio Novo. In Centro do Aguiar, a village between Pau Santo and São Manoel, there was greater resistance from Adelino. Despite state purchase of 200 hectares in the neighborhood to benefit families who had struggled in 1989, it was not until December 2001 that a stronger peasant reaction successfully questioned property rights of Napoleão, the rancher from Piauí to whom Adelino sold the land in 1994.

The period comprised by land struggle and immediate aftermath is undoubtedly distinct from everything those families had experienced before. The effect of such situations on daily activities was even more pronounced given the events that took place in adjacent areas. Gradually, the resolution of each conflict reasserted the need to adjust to normality, in which basic livelihood functions are performed. But as the quotations that begin this section indicate, complex social relations internal to peasant communities have been transforming their existence and challenging their future. In the last decade, contexts experienced by resource-users in Pau Santo and São Manoel have been expanded with the incorporation of additional dimensions of heterogeneity. Other features are added to the cultural diversity between caboclos from Maranhão and migrants from the northeast, to the economic differentiation between wealthier and less

affluent peasants, and even to the social polarization between ranchers and peasants. Mainly, these contexts correspond to the differential inclusion and participation in settlement projects, which constitute instances and opportunities for further economic differentiation among and within communities. In addition, social heterogeneity has been expressed through features related to people's membership and participation in a broad range of local institutions; through cleavages associated with party politics and ideology; and through the manifestation of sharp differences at the level of household and kinship relations. I will therefore conclude this chapter by examining these broader features of differentiation and stratification that contribute to contemporary transformations in the socio-natural ensembles of Pau Santo and São Manoel.

Inclusion and participation in settlement projects. Three related processes take place in this regard. First, resource-users and their respective communities received different entitlements according to their land tenure status. An evident manifestation of this differential treatment is access to credit and other benefits derived from official policies. Even among those who struggled for land, a gradual distinction exists among people and communities comprised by:

- Federal-led settlement projects.
- State-led settlement projects.
- Land adjudications that have not resulted in settlement projects.
- Unofficial agreements mediated by the Catholic Church.
- Common land-use situations in which people solved conflicts with their own means.

Although villages that currently conform to these social situations presented comparable land tenure until the 1970s, the form through which their struggle evolved and the mechanism used for the resolution of these conflicts resulted in radically distinct entitlements. Resource-users of the last three categories have practically no rights in any

sort of localized land-reform policy, while those living in the first two are entitled to some (for the state-led projects) or several (for federal-led projects) benefits. These different entitlements can be assessed as a reward for the collective action against social injustices and economic oppression. But in the long run, the categorization of peasants as settlers on lands of agrarian-reform tends to set boundaries to, and constrain the dynamic nature of social relations and the spatial mobility of this society.

Second, the underlying principles and goals of land-reform programs include settlement policies targeting the installation and consolidation of a rural middle class of producers. According to a developmental perspective, their insertion in product and factor markets justifies the allocation of resources to such agrarian interventions. This privileged group of producers tends therefore to differentiate themselves economically from the rest of the peasantry. However, given the scarcity of means in rural Maranhão to provide even for basic benefits to the general population, activities comprised by settlement policies in land-reform areas with consolidated peasant occupation end up aggravating distinctions between settlers and non-settlers from the same community.

Third, even within the more restricted group of land-reform beneficiaries, the economic benefits of settlement projects give room for distortions in the distribution and appropriation of resources. INCRA protocols specify that the initial phase of a settlement project¹³ should support the installation of beneficiaries in their plots, including subsidized loans, credit for productive activities, and investments in infrastructure.

¹³ According to the Agrarian Reform National Plan, settlement projects carried out by INCRA include plot demarcation, subsidized credits for food (*crédito alimentação*), housing (*crédito moradia*), supplies (*crédito fomento*), and productive activities, the latter funded by the National Program for Household Agriculture (PRONAF, Programa Nacional de Agricultura Familiar), and the National Program for Credit to the Agrarian Reform (PROCERA, Programa Especial de Crédito para a Reforma Agrária). Basic infrastructure in settlement projects should include roads, electricity, water supply, and schools. (INCRA 1985, 2001).

Pau Santo settlers, after over five years of frustrated expectations, began to receive these benefits in 1991. As settlers opted for common land tenure, plot demarcation was not needed. Still, in the 1993-95 period, the association of settlers was in charge of receiving, distributing, and managing resources for three projects that totaled over US\$120,000: crédito fomento (1993), for basic supplies, in the amount of about \$100/household, for 50 households; crédito PROCERA (1994), distributed among 28 productive activities, adding to roughly \$45,000; and crédito habitação (1995), to build 37 houses, in the amount of circa \$1,900/household. In addition, since 1996 the association has been responsible for contracting for infrastructure projects: road improvement and the building of two bridges, the provision of electricity to all houses, the digging of an artesian well, and the construction of a large warehouse. Current conditions of community organization and capacity building in Pau Santo were simply insufficient for the proper implementation of all these activities, hastening internal mistrust and generalized accusations. On the one hand, people no longer trusted in the honesty of certain leaders for project implementation:

In my opinion this is all about cleverness. I see that, but I don't complain. Others cannot stand it, and criticize, denounce the fact that someone wants to be the clever one. They say that those managing the projects are the ones being benefited, getting everything... Lately, there has been no financial accounting here. All these projects, and no accountability! Of course some people are honest, but others are not. That is why people say that someone got the cash and no one knows how it was used. In no way will this get right. Raimundo sold pigs, goats, and nobody knows about the money. The right thing would be to call the association and show the numbers, but this has never happened. There were five trucks with rice to process, and then to sell. Some of those in charge accounted for part of what they did, while others did not do that. So, has this rice disappeared? Maize, there were two trucks... That is how it is. (José Brito)

But on the other hand they were affected by changes in macroeconomic policy and insufficient technical assistance. While the fomento and housing credits assumed the

character of grants, productive activities funded by PROCERA are actual loans to be paid after 6-10 years at subsidized interest rates and discounted indexing (monetary correction).¹⁴ By the end of 2001, one of the greater apprehensions within Pau Santo was the defaulting of such financial obligations. In São Manoel, settlers are not threatened by unpaid loans. The area received fewer benefits, but those included housing improvement, road, electricity, and water supply. Moreover, the association in São Manoel was cautious with settlers' demand for bank credit for productive activities. Focusing solely on a livestock project, they were able to consolidate that initiative and repay their debt.

Contrary to São Manoel, the transfer of leadership from the domain of land struggle to processes of organizing production, processing, and commercialization has been particularly challenging in Pau Santo, especially when community participation and empowerment are supposed to be the basic guiding principles in project implementation. These developments make even more important the strengthening of local capacities, organizational processes, and the role of local institutions, which are addressed next.

Local institutions and community membership. Residents of the clusters of villages centered in São Manoel and Pau Santo form the community of the respective name, regardless of internal distinctions. Examined at a finer scale, however, these communities can be disaggregated into layers that correspond to formal and informal institutions with distinct objectives. While events related to land struggle limited a full manifestation of these layers and constrained internal competition among institutions, socioeconomic and political contexts that favor greater expression of diversity contribute to the multiplication of such institutions and with increasing oppositions among them.

¹⁴ Because of discounted monetary correction, PROCERA loans were easily paid during times (pre-1994) of three-digit inflation in Brazil. Lower inflation rates resulted in greater, realistic financial burdens.

The base Catholic community (*comunidade eclesial de base*, or CEB) is perhaps the first institution installed in most of Maranhão's villages. Composed of the group of active Catholics of a village or group of villages, CEBs are led by dirigentes who perform religious services, and by associates in religious education (*catequistas*). Most CEBs include a board of directors and counselors. São Manoel is one of the better-organized base communities in Lago do Junco, and one of the few villages with no other religious denominations. Aside from the Catholic community, Pau Santo includes a Pentecostal group with increased visibility since the end of the land conflict. Yet, conflicts with religious motivations are limited in the region.

A greater effect is exerted by the mandate and practices of producer associations with direct stakes in socioeconomic issues. Indeed, since the early 1980s' struggle in José Machado, most communities that claimed tenure rights have created an association of producers. By 2002, three associations exist in São Manoel, and two in Pau Santo. In São Manoel, the first one was formed in 1987 with all 31 beneficiaries of the settlement. This group was split 12 years later, and another association was created with 13 of the original settlers, who in 2001 opted for land partition and individual property rights. In addition, an association of residents (*associação de moradores*) was created in 1997 with the membership of non-settlers. In Pau Santo, an association of residents was established in 1997, over a decade after the creation of the association of (settler) producers, in 1986.

Producer associations initially borrowed practices and leadership from the base communities, the dirigentes most of the times performing the duties required by the office. These institutions became critical to settlement activities, first through regulating land tenure and land-use planning, and then by mediating the design and implementation

of projects through a dialog with governmental and nongovernmental organizations. Since the early 1990's these associations were acknowledged by land agencies as legitimate representatives of the beneficiaries. In São Manoel, the state government, upon receiving partial payment for the land, conferred formal landownership to the association. The same did not apply to Pau Santo and other federal areas, as INCRA has only recently accepted common or collective landownership as legitimate.

Associations of producers that included only the beneficiaries of settlement projects were the only such institutions in São Manoel and Pau Santo for over a decade. Their operation, however, contrasted in several aspects. First, in regard to participatory processes: while in Pau Santo only two presidents were appointed along the first decade, power turned over five times in São Manoel. Second, one of the most telling indicators of an association's acceptance by its members was the accomplishment of a major duty, which consisted of imposing labor requirements on behalf of the common property. Both associations began to require labor allocations since their establishment. In São Manoel, *dias de serviço para a sociedade*, or the "society workdays" are still accounted with particular accuracy and sophistication. The initial annual requirement was 24 workdays for each family. Since 1996, those who contributed with 12 workdays per year have the right to keep one head of cattle on the property common pastures. Those with 2 or 3 head had labor obligations increased respectively to 18 and 24 days. And those with more than 3 head had either to pay an extra fee to the association, or to rent pasture somewhere else. In Pau Santo, to the contrary, it has been over eight years (since project implementation has intensified) that the society workdays have been extinct, and land-use planning began to collapse. Antonio Batista, a union leader who was active during land struggle,

expresses in his narrative the dilemma that currently sets Pau Santo's settlers in opposition. Peasants are labeled as either lazy or greedy ones.

Today there is more inequality. One day I said to Lurdes, who has 14 cattle, that I get really upset when I see a member of this society invading this land--a common good--to install private property. I feel bad. If he was raising his cattle inside the common pasture, and if I don't raise any, I couldn't say a thing, because someday I might do the same. But he has occupied land at his own will, and is growing with no limits. I said I was very upset, and then he replied to me, that I don't do the same because I am lazy ('preguiçoso'). I was rude with him, and replied: and you, you do it because you are the greedy one ('ganancioso'). (Antonio Batista)

In addition to greater (Pau Santo) or smaller (São Manoel) quarrels within settler's associations, competing institutions were more recently formed in both communities. Since 1996, villagers aligned with Haroldo Leda--Lago do Junco's then mayor--constituted parallel associations with the intent to weaken the power of existing institutions through a more effective channel for accessing resources and benefits that ultimately served to strengthen the political power of Leda and those aligned to him.

The resident's association is for those who were not part of the struggle. It is for our children, and for other people who live in the village. But things now are different from before, when all projects, even governmental ones, used to arrive to and be administered by our workers' organizations. Now there are agreements with the City, the government, and those federal and state representatives also interfere. Mayors are getting involved with the associations. And mainly this one is, as he is very close to the state governor. He has free access to the governor, and therefore it is much easier to get projects approved. (José Brito)

Opposed to such strategies that transform but maintain the relations of power sustaining local elites, the Rural Workers' Union, the Agro-Extractive Cooperative, and the Rural Worker Women's Association are grassroots organizations in Lago do Junco with an active participation of leaders from São Manoel. The political and ideological orientations that affect community life, intrinsically related to the nature of disputes among institutions that operate at the very local level, are examined next.

Party politics and ideology. If the resolution of land struggles and the elimination of the threat of eviction in Pau Santo and São Manoel gradually allowed social relations to return to normal, the networks of civic engagement established along this trajectory were still operational afterwards. Coalitions established during land conflicts and initial stages of settlement projects did not end with the resolution of the former and approval of the latter. Rather, the post-conflict context is marked by the participation of the leadership in broader social processes, which offer renewed opportunities to express a wider array of individual orientations, ranging from features based on simple preferences and reciprocity, to political ideology. In effect, it was in the realm of ideology, or more directly, of party politics, that the relaxation of the struggle for direct survival expressed alternative dimensions through which structures of power affect social configurations.

Between the mid-1960s and 1986, when the military regime restricted political participation in Brazil, only two legal political parties existed in rural Maranhão. Local elites were organized in the governmental party (ARENA, later PDS--Partido Democrático Social, the Social Democratic Party). On the other hand, those opposing and contesting the regime were aggregated under MDB (later PMDB--Partido do Movimento Democrático Brasileiro, the Party of the Brazilian Democratic Movement). This polarized structure no longer existed by the 1988 municipal election. Political democratization in Maranhão produced a split within the opposition: part adhered to PSB (Partido Socialista Brasileiro, the Brazilian Socialist Party) while others joined the Workers Party (PT (Partido dos Trabalhadores). Up to 1992, PSB and PT coalesced in Lago do Junco for local and state-level elections, electing two city commissioners in 1988 and 1992. This coalition was no longer possible after 1996, when Haroldo Leda co-opted PSB leaders.

The above has greatly affected social relations in Lago do Junco, and particularly in São Manoel. Milton Vieira, a former catholic dirigente, was one of the leaders of the community since land struggle. He was elected city commissioner for PSB in 1988, and in 1992 became president of the rural workers' union. Vieira's decision to break ties with PT and join Haroldo Leda's political group had consequences way beyond party politics. First, his leadership in São Manoel successfully convinced almost half of the local settlers to persistently contest projects and decisions of the association of producers, and urged them to ultimately require and obtain individual land plots. Second, it was through the collaboration of Milton and other PSB leaders that the municipal government was able to undermine the organization of rural workers and install dozens of dwellers' associations in the countryside—including São Manoel and Pau Santo. Third, reelected in 1996 for the City house (câmara de vereadores), Milton was critical in a 1998 scheme to frame and imprison PT's most eminent leader in Lago do Junco. Zeca, who resided in São Sebastião and was in his second term as city commissioner, had been accused—as several others, including Vieira himself--of a murder during the 1989 conflict in Centro do Aguiar. Although five other people were listed, the only one incriminated was Zeca. After spending over two years between jail time and parole, he was acquitted and freed early in 2000. He ran in that year's election and recovered his seat. In the same election, Vieira did not obtain enough supporters for a third term and returned to São Manoel.

Taken together, recent changes associated with project dynamics, with membership and competition among local institutions, and with the dispute for political power through party politics constitute a complex web of interrelated domains through which social stratification is manifested in peasant communities. Yet, the loosening of

land conflicts has also prompted conditions for transformations at a different analytical level that also alters socioeconomic configurations. Such transformations, examined next, are expressed within households and kin groups.

Transformations manifested within household and kin groups. During times of land conflict, confrontations among families or kin groups were embedded in the polarization around the struggle for land. In the last few years, internal differences have been more frequent and provoked greater disturbance in the communities. Yet, while in São Manoel these are expressed through party politics and ideology, the tone in Pau Santo is overtly based on personal and family disputes. In fact, one of the most disturbing events in Pau Santo was a 1990 quarrel between two of the larger families in the village, the Pereiras and Paivas. Although the reason for such disturbance was the extra-marital affair of a young adult of the former with an adolescent of the latter family, this has brought consequences that still today affect Pau Santo's social fabric, over a decade after the fact. Most likely, if it had happened a few years before, the event would not have activated with the same intensity the strong honor codes and values associated with moral conduct. The tension between the two families (who were neighbors and maintained a close relationship) provoked the move of the Pereiras to install themselves elsewhere in the settlement area, which created several complications for the implementation of project activities. Among other things, it has created an internal clash in the association and destabilized social relations and the balance of leadership within the community.

From a rather different perspective, post-conflict conditions in Pau Santo and São Manoel also coincided with the increase in the coverage and the expansion of social

security payments in Brazil after the 1988 Constitution.¹⁵ The new parameters for rural workers came into full effect early in 1992, after the Congress approved implementing legislation. This policy change has transformed the role of the elderly in Brazil's rural areas, particularly in poorer households. Since then the elderly are responsible for most of the cash that circulates within communities, radically changing values and social networks that surround them (this point is detailed in Chapter 6). While, on the one hand, this capital is put to work on productive initiatives that improve the local economy, on the other hand a series of practices and schemes are devised by the "clever" ones in the community, backed up by associates in the city, to benefit from the naiveté of those that are not used to dealing with monetary transactions.

Another aspect through which changes in relations at the household-level affect social configurations is the gendered-based perception of resources, mainly with respect to babassu forests and babassu extraction. In the Mearim valley, the babassu economy assisted the construction of a complex division of labor along generations. The income provided by babassu kernels enhanced women's role in the functions of production and reproduction within the household. Continuous extractive practices significantly contributed to the definition of cultural attributes of the household, and specifically to the empowerment of women (Miyasaka-Porro 1997, 2002). The participation of women in production activities in most Amazonian and northeastern rural environments has been limited to domains controlled by men, with restricted social interactions beyond the domestic sphere. Babassu extraction, on the other hand, represented an active and

¹⁵ The 1988 Constitution granted equal eligibility rights to households headed by men and women; lowered the age at which rural workers could receive benefits; and raised the minimum benefit to 100% of the legal minimum wage from 50% prior to 1988 (World Bank 2001). Oliveira et al. (1997) find that in 1996, three times as many women, and 2.5 times as many men received pension benefits as they did in 1988.

enlarged domain for the construction of practices, discourses and relations that extend women's participation into wider realms of social and political discourse.

Women's role in securing access to babassu was critical in Pau Santo, São Manoel, and in several other communities that experienced land struggles in the region. In addition, the adjustments that households made in extraction and processing of babassu (explained in Chapter 4) attest to a shared perception, among men and women, of the importance of allocating labor to this activity. Yet, tensions have arisen as other production opportunities have recently confronted men and women's perspectives on the land-use types that are prioritized by their respective practices. Fields for semi-perennial crops and the incipient mechanization of annual cropping are examples of land-use activities that push for further reduction of babassu densities. Such cases undermine women's advocacy for the maintenance of palms, this time against the perception of men from their own community, in most cases their own husbands, who view babassu as a constraint to higher productivity of annual fields.

Conclusion

The theoretical argument of this study centers on the dialectic relationship between transformations in social and natural systems, and more specifically, between processes of economic differentiation and social stratification, and changes in land- and resource-use by peasant communities. The present chapter has introduced socioeconomic trajectories and transformations in Pau Santo and São Manoel, as well as the insertion of these transformations into the broader contexts of Lago do Junco and the Mearim Valley. The examination of these trajectories allows a few preliminary remarks.

The first is a product of power relations that permeate the structure of local society, namely the extremely high level of concentration of landownership, which

constitutes a critical constraint for the economic alternatives available to peasants in Lago do Junco. Therefore, the agency of Pau Santo and São Manoel peasants in the last 20 years primarily geared towards the transformation of this feature of the social system.

Second, it is possible to establish a four-phase periodization in the analysis of socioeconomic transformations in the study area. Such periodization is based on the identification of major processes that enacted significant changes in the social system. As is discussed in Chapter 4, each phase is also characterized by corresponding and intertwined changes in the natural system, resulting in aggregated transformations of the complex, socio-natural ensembles of Pau Santo and São Manoel.

Third, despite similarities that appear to exist between the two communities, there is a clear distinction in terms of the trajectories observed in Pau Santo and São Manoel, particularly in the post-struggle. While peasants in São Manoel appear to have been transferred to the post-conflict era the abilities they had shown to recover land rights, the post-struggle trajectory in Pau Santo can be considered a failure according to community development and participatory approaches. A better understanding of these differences is therefore needed, and is provided in Chapter 7.

The four periods identified in the analysis of socioeconomic trajectories in Pau Santo and São Manoel were termed peasantry formation, economic differentiation, social stratification/class struggle, and peasantry transformation. In general terms, each period corresponded to changes in the internal constitution of the peasant social system, paralleled by realignments in respect to the broader society, and particularly in regards to the dichotomy that opposes peasant producers to capitalist ranchers.

The first period comprises an era in which landownership was practically absent and internal hierarchies were not based on economic accumulation or political power. Villages were installed and grew up in this period, and the economy relied essentially on shifting-cultivation, babassu extraction, and the extraction of forest products. The massive arrival of Northeastern migrants in the early 1950s, and consequent cultural collisions, set the boundary to the second phase. Increased commercial operations within villages, and a state-led land process of land privatization were features of the second period that expanded the opportunities for better-off peasants to consolidate their economic differentiation, what also led to their initial adoption of cattle ranching. The transition from the second to the third period is marked by the expansion of state programs and subsidies stimulating pasture conversion and altering the social function of natural resources. In the third period, a clear class distinction can be observed in rural Lago do Junco, with a greater polarization between peasants and ranchers. Management practices by outside ranchers in Pau Santo, and by a wealthier-peasant-turned-rancher in São Manoel curtailed peasant livelihood opportunities and provoked their destitution from the means of production. This process ultimately provoked peasant reaction through intense land conflicts, what marks the transition to the fourth period. In the post-struggle period, currently underway, complex social relations internal to peasant communities have been transforming their existence and challenging their future. Product of dynamic changes along eight decades of peasantry in Lago do Junco, a complex set of superimposing contexts and domains results in an increasingly differentiated society, adding diversity to social relations, production strategies, and interactions with the environment.

These processes and events have ultimately informed what Escobar (1999) terms distinct “regimes of nature” within complex socio-natural systems. In Pau Santo and São Manoel, these multiple contexts have been redefining dynamic ways through which resource-users engage in combinations of agricultural, livestock, and extractive activities, delineating patterns of landscape composition. Examining choices, practices, and interpretations of the patterns of change in land- and resource-use, and their connections with economic inequality and social differentiation is critical to capture the multiple and parallel regimes of nature, or, in other words, to understand the “grounded political ecology” of resource-users in the babassu zone. Therefore, to inform a more complete understanding of the biophysical context in these sites, the next chapter examines in detail the trajectories of land- and resource-use in Pau Santo and São Manoel.

CHAPTER 4

SÃO MANOEL AND PAU SANTO: BIOPHYSICAL CONFIGURATIONS AND RESOURCE-USE TRAJECTORIES

The environmental conditions in and around Pau Santo and São Manoel are likely to deceive the analyst if taken out of context. Although both communities emerged from land conflicts in the mid-1980s with most of their terrain covered by pastures; the distinct trajectories of resource-use observed in the last 15 years reinforce the notion that multiple domains of explanation are implicated in resource-use dynamics, and in the interactions between humans and the natural environment. Today, a larger proportion of land in Pau Santo is covered with higher biomass vegetation, which due to lower labor requirements for weeding allows larger fields and provides higher yields (in Chapter 5, I use remote sensing to compare categories of land-cover in Pau Santo and São Manoel). However, this condition is not likely to prevail in the near future, due to current allocation decisions and management practices of local resource-users. Social relations within Pau Santo are loaded with tension and discord, and impose heavy burdens to common initiatives. Such a condition is reflected in the integrity of local landscapes, as contested relations inform practices that are likely to undermine the environment in the future. However, Pau Santo's apparent head-start over São Manoel should be assessed from the standpoint of a balanced and long-term integration of nature and society.

The main objective of this chapter is to contextualize the trajectories of these communities in terms of resource-use. With this goal in mind, I argue that judgments about landscape integrity should incorporate the concept of resilience not only in terms of

the natural ecosystem, but also in terms of how these components are integrated within socio-natural ensembles. For the purpose of this analysis, and particularly with respect to the land-use/cover trajectories of the last 15 years, the units to be examined in greater detail are the settlement areas in Pau Santo and São Manoel, and not the entire clusters.

This analysis assumes that traditional shifting-cultivation and cattle ranching in Lago do Junco are not viable alternatives in the long run. Less available land for peasants, and increased population growth constrain shifting-cultivation. Extensive management techniques limit the sustainability of ranching. The analysis further acknowledges that agricultural intensification and diversification are still incipient in the entire Mearim Valley. These conditions suggest that assessments of land-use dynamics in the region should focus on the differential adoption of management practices that improve long-term resource-use within current agro-extractive systems.

That said, over a decade of fieldwork in both sites allows me to assert that even though families in Pau Santo's settlement area own almost twice as much land on a per capita basis (see Table 3-4), the planning of resource-use targeting long-term utilization is better executed and enforced in São Manoel than in Pau Santo. Despite the fact that greater land availability partially explains Pau Santo's lower tendency toward agricultural intensification and resource conservation, recent trends in both communities suggest that socio-cultural and institutional factors specific to each village play critical roles, and need to be incorporated in the comparative analysis of resource-use dynamics. Greater natural resource endowments in Pau Santo were not translated into better livelihood conditions. To the contrary, socioeconomic indicators for Pau Santo's residents are considerably worse than those for São Manoel's (Chapter 6). In addition, the discussion in Chapter 7

shows that the discord and instability that pervade social relations in the former contrast with the high degree of cooperation and community mobilization of the latter. With these observations as a starting point, this chapter highlights the imprint of socio-cultural and institutional features of peasant communities on their resource-use trajectories, and, ultimately, on the landscapes that result from these practices.

As seen in Chapter 3, the various institutions in Pau Santo that regulate the access to common goods and resource-use have failed to establish the rules for a sustainable and equitable system. Clearing and cropping on these common lands are done at the will of individuals, resulting in frequent disputes within the group. This is affected by the fact that, contrary to other villages, violence was not suppressed within social relations in Pau Santo, periodically leading to extreme outcomes (Chapter 7 analyzes this aspect in more detail). Among other consequences, these disputes cause sub-optimal use of resources and overall losses that affect future investment opportunities in the community. Initiatives to regulate the use of common land did not succeed. When these initiatives occurred, benefits accrued to a few individuals. In Pau Santo, individuals that hold power take advantage of common goods and assets, appropriating by force these resources for their private benefit. Socioeconomic improvements thus tend to benefit some people and not the entire community. To sum up, Pau Santo's overall economy relies on the cultivation of roças, carried out in an overly individualistic manner, with limited development of the social capital¹ required to improve resource-allocation. Illustrative of this trend is the engagement of Pau Santo settlers in ranching. While the activity is occasional for the

¹ Social capital refers to the aggregate of actual or potential resources that can be mobilized through social relationships and membership in social networks (Scheffer et al. 2002). See also Portes (1997).

majority, a minority of producers encloses common land for private use, therefore reproducing processes of economic differentiation of the past.

Conversely, in São Manoel there has been a gradual improvement in activities related to land-use planning. Formal and informal rules have been developed and followed, and the more limited resources were optimized over the years. Portions of the common lands were set apart and managed as collective pastures, while the remaining area was split between fallow and agriculture. Systematic practices to choose, demarcate, and burn land for crops have been carried out in a spirit of cooperation and by agreement, reducing losses and the accidental spread of fire. Even São Manoel's recent political and ideological fragmentation little interfered in the productive process. Contrary to Pau Santo, several of the settler families diverted economic gains of the last few years to expand their productive basis by purchasing livestock and nearby private landholdings. Ranching has been integrated with crops and babassu extraction by a larger number of families in São Manoel, and is no longer viewed as a taboo or as a symbol of oppression. A collective herd is owned by the local association, used both as a source of revenue for local investments, and for periodical redistribution. As for private herds, when families reach an agreed limit for the use of common pastures, cattle are taken to adjacent, private smallholdings. Practices for pasture and herd management indicate that livestock became incorporated into the productive system, absorbing household labor and resources. In this regard, the maintenance of babassu-filled pastures provided conditions for the integration of the extractive activity within agro-pastoral livelihood systems.

A full explanation of the specificities that distinguish one community from the other may run the risk of conveying the notion that every case is unique unto itself and

that no broader generalizations can be suggested. While this is true in the narrow sense that each situation does indeed have its particular history, such particularities can nonetheless be conceptualized and understood within the more abstract approach presented in the first two chapters. The terminology and the perspective developed in those chapters invite us to think about the present (and the future) situations in São Manoel and Pau Santo in terms of configurations of socioeconomic and biophysical factors that together comprise the context or ensemble that drives many of the land- and resource-use decisions made by individual households, and that determines the characteristics of the social and natural organization at the more aggregate level of community and region (e.g., shifts in the pattern and degree of social differentiation as well as changes in the physical landscape). As presented, the analysis considers the details that distinguish the environmental and the social histories of each community, but interprets these specificities within a broader conceptualization of the relationship between human and social organization, and the natural environment.

Aiming to understand the specificities that led to the disparity of resource-use trajectories between Pau Santo and São Manoel, a brief description of the biophysical features and main vegetation categories of the Mearim Valley is appropriate, followed by a portrayal of the three major components of livelihood systems in the region: babassu extraction, shifting-cultivation, and cattle ranching. I then examine land-use/cover change dynamics in the two communities since their establishment--and mainly after their struggle for tenure rights. This examination is based heavily on the analysis of narratives that capture local perceptions and explanations for such transformations. The tone used in most of the narratives, and the structure through which they are presented, may reveal a

predisposition against the ensemble of socio-natural relations currently operating in Pau Santo. These judgments, however, reveal constructions of a particular mode of interpretation, which should not be the only one applied to study peasant communities.

Biophysical Features: Climate, Soils, and Vegetation of the Mearim Valley

Positioned at the easternmost part of the Brazilian Legal Amazon, Lago do Junco is in the mid-portion of the 111,000 km² wide Mearim river basin, the largest in the state. The basin also comprises the Grajaú and Pindaré rivers, and numerous smaller streams and temporary watercourses (igarapés). One of these igarapés, the Pau Real, forms the natural divide among the municipalities of Lago do Junco, São Luis Gonzaga, and Bacabal. Lago do Junco is some 30 miles west of the Mearim, a 966-kilometer river that flows south to north, draining to the Atlantic Ocean (see location in Figure 1-1, page 5).

Topography throughout the region is flat to slightly rolling, with elevations reaching no more than 150 meters above sea level. Local climate features a dry season of 5 to 6 months, each with less than four inches (100 mm) of rain. Monthly average temperatures range from 24 to 29° C., with minimum lows at 18° C., and maximum highs of 36° C. The dry period is known as summer (verão), and runs from June to November, when the wet season (inverno) begins. Annual rainfall ranges from 40 to 60 inches (1,000 to 1,500 mm), allowing rain-fed cropping. Soils in the region are mostly of medium fertility, mainly oxisols, ultisols, and alfisols. High-density stands of babassu palm have been associated with relatively fertile soils such as Ustalf and Udalf (Anderson et al. 1991:19), and lands near waterways have their soil fertility enhanced by alluvial deposits. Yet, according to conventional agronomic classifications, upland soils in the region are inappropriate for agriculture unless conservation practices are used, which seldom occurs.

Today, Lago do Junco's vegetation corresponds to the terrestrial eco-region of Maranhão Babassu Forests (WWF 2002). Maranhão babassu forests are included in the tropical moist broadleaf forests biome. They are characterized as a transition zone with floristic components of the moist evergreen forests of the Amazon basin, the woodlands and scrub savannas (*cerrados*) of Brazil's central plateau, and *caatingas*, the dry vegetation of Northeast Brazil. Species-rich moist deciduous forests were originally featured in the area, but--given long-term human activity--almost no longer exist in the entire Mearim Valley. In Lago do Junco, the anthropogenic action began in the 1920s and affected the whole municipality as early as the 1970s. Humans altered the original habitat through frequent cutting and burning events for annual cropping, on lands later converted to pasture. Small remaining fragments of mature forests or species-rich secondary forests are found only on the hilltops in less accessible terrain. Gallery forests, wet savannas, and seasonally flooded grasslands occur at the edges of rivers and waterways.

There is no doubt, however, that the most important environmental feature of Lago do Junco and in the entire region is the pattern of secondary succession with predominance of babassu (*babaçu* in Portuguese). A species that grows sparsely in the original habitat of primary forests, the babassu palm (*Attalea speciosa*, formerly *Orbignya phalerata*)², proliferates after land clearing, and constitutes the most dramatic example of what Peters (1992) termed as "oligarchic forests" in the Amazon.

High-density stands of babassu occur in the transformed landscapes after deforestation. This is due to the palm's fire-tolerance, the thickness of its fruits husks, and the plant's extraordinary capacity to regenerate after cutting. The babassu palm

² Anderson et al. (1991:205) describe the taxonomic confusions pertaining to the classification of babassu.

benefits from human economic strategies, and remains in the landscape either dispersed over pastures planted with exotic grasses for cattle ranching, or growing in more dense stands in areas for slash-and-burn, shifting-cultivation. Even though babassu forests are not as rich as other Amazonian eco-regions in terms of biodiversity,³ these forests play a critical ecological role as a buffer zone between dryer areas of the Northeast and the evergreen forests of the Amazon. In addition to its ecologic importance, babassu provides economic goods and services that are critical to the largest peasant population in the Amazon. Hence, the palm is regarded as the most important “subsidy from nature” (Anderson et al. 1991; Hecht et al. 1988) to the livelihood of people in Maranhão.

The interplay of economic and ecological relevance of babassu stems from the species’ population dynamics, largely affected by human action. The fact that babassu is the most prominent species after practices that transformed the original landscape in the region is verified through the typology of vegetation categories in the area, which centers on the presence or not of babassu, and in which life stage of the palm predominates.

Vegetation Categories in the Mearim Valley

Mature Forests (Mata, Mato Grosso)

In the Mearim Valley, remnants of relatively stable forest formations only occur in a few areas with lower degrees of human disturbance, mainly hilltops and riverbanks that are more difficult to access. Given their shade tolerance, high densities of seedlings and stemless juvenile plants grow in closed forests’ understory, where low densities of adult palms are found (Anderson and Anderson 1985:42). Studying the structure of primary forests with a relatively stable composition in the Mearim Valley, Anderson

³ According to WWF (2002), 112 mammal and 268 avian species were recorded in Maranhão’s Babassu Forest eco-region, compared, for example with 149 and 153 mammal species, and 517 and 527 bird species

(1983) estimated that babassu corresponded to 20% of the 386 stems from 63 species, including adult and juvenile individuals. In addition to forests not significantly disturbed (primary forests), mature forests include capoeiruçu, the name for secondary vegetation after roughly two decades of clearing. Although species diversity in capoeiruçu is lower than in primary forests, the remaining seed-bank and the regeneration of multiple species after a single clearing allow for a pattern of succession that is not yet entirely dominated by babassu. The density of babassu is therefore higher in capoeiruçu than in primary forests, and even higher after successive cropping cycles.

Cropland/Babassu Associations (Roça)

Traditional systems of shifting-cultivation in the Mearim (treated in more detail later in this chapter) involve the clearing of land for annual agriculture. Through this operation, few trees of originally forested landscapes are left standing. However, in areas with high palm density, the biomass provided by the burning of babassu leaves makes the clear-cutting of most palms unnecessary. These palms will only have their leaves removed. Babassu is resistant to fire, and palms that had their leaves removed will then recover and remain in the field. Areas where shifting-cultivation is the predominant agricultural system thus consist of a patchwork of fields, some in production and others at different fallow stages. Fallow periods that formerly lasted up to two decades recently dropped to less than four years. Cropland therefore corresponds to the fields being worked in a given year. Cropland also presents inter-annual variation according to the stage of crop development. Variations include the predominance of dry biomass after tree felling and the cutting of babassu leaves (July-August), bare soil after burnings (September-November), the germination/seedling phase (December-January), the peak of

the vegetative phase (February-April), and the drier, harvest and post-harvest phase (May-June). In areas of more recent clearing (and higher fertility), land is cultivated in two sequential years with rice and/or maize. More commonly, however, cultivation only lasts one cycle, and manioc is the only crop that remains in the ground after rice and maize are harvested. After the harvest of the last crop, these fields will remain in fallow and turn to capoeiras.

Second-Growth (Capoeira)

Capoeiras correspond to the different stages of vegetation succeeding agricultural use, prior to this vegetation's recovery of the stable condition of mature forests. Although soil type and original vegetation are key for the outcome, this second-growth can be roughly differentiated in terms of fallow time and average vegetation height. Capoeira fina is initial secondary succession, after fallow periods of up to four years. Capoeira grossa corresponds to advanced secondary succession, after fallow periods of more than four years. The average increment in height of capoeiras in the region is 1-1.5 meter per year. Capoeiras may also follow degraded pastures, although the term in Maranhão is more often associated with lands used for cropping. After multiple fallow cycles, species diversity is reduced and babassu predominates in the structure of secondary vegetation, comprising up to 80% of the stems. In the Mearim, average babassu density in capoeiras reaches more than 110 adult palms/hectare (MIC/STI 1982). In addition to palms at the reproductive stage, babassu stands also include younger individuals: juvenile plants that have a trunk but are not yet fully developed to flower and fruit (palmitos, or capoteiros), and a very large number of trunkless individuals, ranging from seedlings to plants 4-5 meters in height, and up to about four years old (pindovas).

Palmland (Palmeiral)

Palmlands are formed after extended fallow periods, due to an interruption in successive cropping cycles or because of pasture abandonment. Palmland corresponds to a vegetation stage that succeeds capoeiras, when species diversity is reduced and the land is not used for agricultural purposes. The development of other types of vegetation and overall ecosystem diversity had been prevented by sequential cropping cycles and/or pasture establishment that depleted existing seed-banks. Nutrients and biomass were thus progressively accumulated within the upper strata of adult babassu palms, which suffer little competition, and reach a second ecologically stable state. In this state, the closed canopy of an upper stratum is combined with the high density of juvenile individuals in the understory. Densities of over 200 adult and 750 juvenile palms were observed in palmlands of the Mearim (Peters et al. 1989:346). Older isolated palms (coringas) are also present, detached from the newer, lower stands.

Pasture and Babassu Associations (Pastagem + Babaçu)

Pastures are usually installed in previously cropped areas that include high densities of adult palms. The conversion of capoeiras to pasture is frequently combined with annual crops. In this case, manioc is not planted, and pasture grass is sown while rice and/or maize receive the second weeding. Such practices result in a considerable number of palms (more than 50, and up to 100 adult palms/hectare) remaining within pastures. From the 1960s to the 1980s, jaraguá grass (*Hyperrhanya rufa*) was the species most used to create pastures in the Mearim, while brachiarias and andropogon were increasingly introduced in more recent years. The endurance of the babassu seed-bank, and the palm's cryptogeal, or hidden form of germination, allow delayed sprouting and regeneration in these areas. These propagation strategies form real "carpets" of seedlings

and pindovas that are periodically eliminated in clearing operations. For the purpose of classification, the typology distinguishes pasture/babassu associations according to the density of adult palms: high (more than 75 adult palms/hectare), medium (between 50 and 75 adult palms/hectare), and low (between 25 and 50 adult palms/hectare). Table 4-1 shows densities of adult and juvenile babassu populations measured within capoeiras and pastures of Pau Santo and São Manoel, in July 1999.

Table 4-1. Density of babassu populations in sample sites in the Meairm Valley

Land-cover category	Sites	Adult (palms/ha)	Juvenile (pindovas/ha)
Pasture (two years after cleaning)	10	57 (19)	4,263 (2,160)
Pasture (recently cleared)	14	58 (6)	4,011 (2,650)
Capoeira grossa	8	71 (8)	3,571 (1,850)
Cropland (after rice harvest)	4	68 (3)	3,850 (1,093)

Notes: The population of adult palms was sampled on sites measuring 2,500 m². Four subsets of 100 m² were defined for each of the 36 sites, to sample the population of juvenile babassu plants. Results were converted to plants/hectare. Values in parenthesis indicate standard deviation.

Open Pasture (Pastagem Limpa)

Capital-intensive ranching operations feature the replacement of jaraguá grass by brachiaria, and the drastic thinning or elimination of babassu stands. Reasons for the elimination of palms range from technological (management preferences), to ideological ones. The result is predominantly open landscapes that may include just a few palms or trees (less than 25, but usually no more than 10 adult palms/hectare). The conversion of jaraguá pastures to brachiaria also results in a more effective control of the emergence of babassu seedlings and palm regeneration, as these grasses aggressively cover the land surface. Pastures directly installed after the clearing of undisturbed forests include smaller densities of adult palms. Unlike the predominant pattern in jaraguá pastures, brachiaria's aggressive surface coverage suppresses the development of babassu, challenging the long-term continuity of pasture/palm associations.

Bottomlands (Baixões)

Bottomlands are seasonally flooded areas featuring gallery forests along watercourses, or grasslands after these forests are cleared for rice cultivation. Grasses known as tango, brachiaria d'água, and capim duro are common in bottomlands. Excess moisture limits the development of babassu. While gallery forests have intra-annual resilience, bottomland grasses show seasonal variation in the amount of biomass. This variation, however, is less pronounced than in upland pastures, and is restricted to the peak of the dry season.

Landscapes that surround Pau Santo and São Manoel are primarily formed by these seven categories. Figure 4-1 illustrates vegetation categories in Lago do Junco, and Figure 4-2 shows the different life stages of the babassu palm. The occurrence and density of babassu stands is the major feature distinguishing among such categories. The relative allocation of resources among three main economic strategies, and the adoption of management practices by resource-users in these communities are the proximate factors that led to the predominance of one or more of these land-cover types. Therefore, in what follows I discuss the major aspects of these three economic activities.

Livelihood Components that Affect Land-Use and Land-Cover in the Mearim Valley Babassu Extraction

Products and services obtained from babassu constitute a significant portion of monetary and non-monetary income for people in the Mearim valley. Kernels are sold by extractors in every village for cash or traded for basic supplies. Most kernels are then sent to processing plants in Bacabal, Pedreiras, Codó, São Luis, or Teresina, and transformed into babassu oil.



Figure 4-1. Vegetation categories in Lago do Junco. A) Gallery forest; B) Upland forest remnant being slashed; C) Cropland after fire; D) Recent babassu second-growth; E) Jaraguá pasture/recent second-growth; F) Intermediate second-growth; G) Cropland (rice field in bottomland, after harvest); H) Bottomland pasture (*brachiaria d'água*); I) Jaraguá pasture/babassu association.

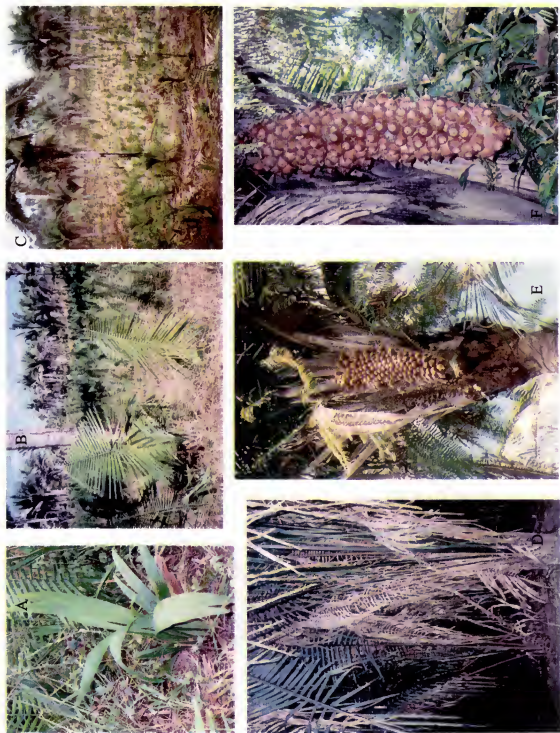


Figure 4-2. Life stages of the babassu palm. A) seedling; B) and C) capoteiro; D) pindovas; E) and F) adult palms.

In Lago do Junco, part of the local production of babassu kernels is processed at COPPALJ, the Agro-extractive Cooperative.⁴ Babassu oil competes with palm oil and palm-kernel oil in the cosmetic and food industries, while oil by-products are suitable for animal feed. Babassu oil is produced domestically by cooking a paste obtained by crushing roasted kernels in wooden mortars. In addition to kernels, a renewable charcoal from the woody fruit endocarp is the cooking fuel most used in Maranhão, with growing markets for industrial use after conversion to coke. The fruit's mesocarp contains 10% starch, and is consumed locally.⁵ Thatch and stems are widely used as construction materials and for utilitarian crafts. A number of other products are obtained from this palm, justifying its designation as "the tree of life" (Anderson and Anderson 1985).

Babassu fruits fall naturally on a year-round basis. Higher production in the Mearim region, however, occurs from August to January, declining to about half that amount during the other six months. Babassu extraction is carried out predominantly by women and children. Walking mainly in groups, they leave the villages in the morning, heading to the palm stands to gather fruit. Some spend most of the day collecting babassu and extracting kernels at the collection sites. Others--mainly those who own draft animals--prefer to stockpile fruits in their backyards, where they will be cracked throughout the week. Provisions for the rainy season are also desirable, when availability dwindles, and the conditions for gathering fruit worsen. Both forms of collection assume free access to resources.

⁴ COPPALJ began to operate in 1991, and initiated the production of babassu oil two years later. In the 1996-2001 period, COPPALJ processed an average of 500,000 kg of babassu kernels/year.

⁵ The Cooperative of Agro-extractive Producers of Esperantinópolis (COPAESP) processes babassu mesocarp into starch since 1998. The product is sold in local markets and regional drugstores.

In situations where access to babassu is not granted, the activity is carried out through more restrictive practices and more formal labor relations. In villages of landless peasants, mostly near highways, landowners or contractors pay wage laborers to gather and load babassu onto trucks. The truckloads of fruit are then delivered to villages in order to be cracked by women who receive half of the market price for kernels. Women have no right to keep the husks for charcoal, as the “owners” of this babassu sell the husk to industrial plants, to be used as fuel. Other situations of constrained babassu extraction involve the payment of labor obligations to landowners (usually the clearing of pastures), or the renting of babassu stands to a contractor who exploits that area in exchange for a cash payment. In this latter case, access is restricted to the majority of the population.

Cracking babassu (*quebrar coco*) is a dangerous operation. The fruits are placed on the edge of an upright hatchet blade and struck with a wooden club several times until the kernels are dislodged. Men at times engage in fruit gathering, but only those particularly skilled extract kernels. Other babassu-related activities, however, include a strong male role, such as the production of charcoal and the cutting of leaves for thatch. As for the services provided by this palm, the high biomass of its leaves, and the remarkable regeneration capacity of the palm, improve conditions for both agriculture and cattle herding. Scenes of babassu extraction are shown in Figure 4-3.

Features associated with the structure and ecology of babassu populations are critical to the long-term future of this activity. The palm’s dominance in regional landscapes consists of a clear two-stratum population: a lower stratum of seedlings and juvenile palms (periodically eliminated in areas converted to pasture), and a superior layer of adult palms. Although babassu’s lifespan reaches up to 184 years (Anderson et

al. 1991:74), the elimination of juvenile palms in current management practices on pastures and short-term-fallow fields, makes it likely that the dominance of babassu will be drastically reduced following the senescence of adult palms. To avoid such a drastic transformation, management practices are needed to allow the recruitment of juvenile palms and the consequent renovation of babassu populations.



Figure 4-3. Women and children of Lago do Junco working in babassu extraction.

Shifting-Cultivation

Roça is the most common term for swidden fields in north and northeast Brazil. In the Mearim Valley, roças are a predominantly male activity, cultivated with rice (the main product), maize, manioc, and beans, individually or in different combinations of intercropping. Portions of a roça are occasionally planted with small quantities of other intercropped vegetables such as squash, okra, or watermelon. Producers endowed with enough resources establish roças on both upland and lowland areas, thereby reducing their risk of crop failure. Rice production in upland sites is limited in years of lower rainfall, while lowland sites are susceptible to losses in years of high rainfall and floods.

Land clearing begins in June-July. Operations include slashing and lopping the under-story with a sickle (broque), tree felling using an ax or machete (derruba), and the trimming of palm leaves (desbandeiramento). After the vegetation dries, fire is set in September or October. To clear land for cropping, trunks and twigs not consumed by fire are then piled (coivara) and re-burnt. Cropping starts with reliable rains, usually in December. Large assortments of local varieties of annual crops are utilized. Rice and maize are planted with a pointed stick, or with a hand planter (matraca). For early consumption, small areas are cultivated with less productive, 90 day-varieties (arroz ligeiro). More productive stands have a 120-130 day cycle and are sown in larger areas. Highly productive, water-demanding rice (arroz lageado) ripens in 150-160 days.

Weeding is the most labor demanding activity in short fallowed areas. Harvesting is the greater burden in fertile, long-fallow fields. Instead of using hoes, weeding is done with a small, curved sickle (cotelo), or a large knife (colinho), and begins right after rice is sown or before sprouting. Two or even three passes are needed, in contrast with a light, single pass in longer fallowed lands. No fertilizers are used, and insecticides are seldom

applied. Herbicides are increasingly used in sites infested with grass, mainly in lowland areas. The harvest of rice starts in April and extends to June in wetland areas. Maize is harvested in June/July. If household labor is insufficient for the timely harvest of large fields, laborers are paid by productivity, receiving one third of what they harvest, or cash equivalents. Rice is harvested with a small blade adjusted to the palm of one's hand. Rice bunches are cut individually. Grains are first stored on the sheaf in a temporary shelter (paiol) in the field. Once dried, rice is manually threshed and finally carried to a permanent storage inside or near the house. Some maize is harvested and eaten ripen in March/April, but most stalks are bent over only upon the harvest of rice, the ears being gathered when totally dry. Scenes of shifting-cultivation are shown in Figure 4-4.

Manioc stays longer in the field, and therefore is treated as a safety crop for the provision of food or cash when rice supplies are small. Manioc is less demanding on soil fertility, and is therefore more appropriate when resources are limited. Farinhada, or the making of manioc flour, occurs on a year-round basis. It involves the entire household, and sometimes even extra labor is required. Two draft-animal loads (cargas) of roots produce 50 kg, or one sack of manioc flour. Roots directly peeled and crushed produce a dryer, whiter kind of flour (*farinha branca*, *farinha seca*). Roots immersed for 2-3 days in a water tank or stream produce a more sour, larger-granulated, and yellowish flour (*farinha d'água*, *farinha puba*). Manioc starch, locally known as *goma* or *tapioca* is obtained by squeezing and filtering a paste produced upon crushing manioc roots. Manioc flour results from toasting the paste in wood fueled ovens. As more starch is withdrawn from the paste, the quality of the flour declines.



Figure 4-4. Shifting-cultivation in Lago do Junco. A) Rice harvest. B) Field storage of rice. C) Manioc manioc field. D) Manioc processing (farinhada).

Finally, beans are only rarely intercropped within roças. Beans are preferably cultivated at the end of the rainy season, when moisture is reduced. Sites with enough biomass are best for a slash-and-mulch system for beans (*abafado*). Neither fire nor weeding is required. In areas of less-developed vegetation, however, beans are cropped under bush-fallow (*lastro queimado*), or in labor-demanding mounds (*leiras*). Except in areas of bean cultivation, land should remain in fallow at least five years before another roça is set on the terrain. Land scarcity in the Mearim, however, reduces these intervals to 3-4 years, prompting decreasing yields and challenging peasant livelihood.

Cattle Ranching

Shifting-cultivation and babassu extraction are predominantly associated with diversified peasant livelihood systems. Ranching is a strategy adopted by a wider range (although smaller number) of resource-users in the Mearim Valley. Yet, rather distinct systems of production are featured in the ranching that occurs in the Mearim. On the one hand, there are those diversified livelihood systems in settlement areas, and in small- or medium-sized private landholdings. On the other hand, wealthier or elite landowners specialize in this activity. These, in turn, can be distinguished according to whether they employ labor, or capital-intensive technologies, and if the unit is specialized in beef cattle, or includes dairy production. All four combinations exist among ranchers in the region, with an important dairy belt near Pedreiras. In Lago do Junco, however, there are no commercial dairy units. Ranching operations also differ from agriculture and extraction given their limited presence in the Mearim up to the 1960s. In the last three decades, however, little land in the region was left as forest fallow, and since the late 1970s most peasant villages are surrounded by pastures devoted to raising beef cattle of Indian (nelore) and mixed breeds.

One of the features that best differentiates between ranching systems is pasture management. The African grass *Hyperhanya rufa*, named jaraguá or lageado, was the most commonly used in the Mearim. The cost of felling babassu during pasture formation contributed to the maintenance of adult, productive palms within these pastures. More recently, however, landowners with greater economic resources eliminated palms and replaced jaraguá pastures with more aggressive brachiaria grasses, mainly on lands near highways or closer to cities. Besides greater upfront investment, this replacement requires capital-intensive pasture management. It nonetheless represents a lower labor demand

due to the ability of the brachiarias to suppress the emergence of other plants, including juvenile palms. Conversely, most of the traditional, resource limited ranchers, practically all of the medium-sized holders, and peasants that raise cattle, still rely on management systems that include jaraguá grass, maintaining moderate to large densities of palms. Indeed, when density is not excessive, the upper layer of adult palms is said to improve microclimatic conditions for raising livestock. Partial shading and a deeper root system allow retention of soil moisture and reduce cattle mortality under extreme heat-stress.

In addition to microclimatic improvements, income provided to landowners by the sale of babassu kernels obtained in these pastures would suggest the maintenance of adequate palm densities and commercial arrangements for the exploitation of babassu. However, in areas where landownership and the access and control of babassu stands are contested, such practices tend to aggravate conflictive situations. Faced with such a dilemma, and aiming to reduce the entrance and activity of peasants on their properties, ranchers tend to forego babassu's beneficial role and restrict extraction. Because babassu is perceived as a symbol of peasant resistance and struggle, well-off ranchers reduce babassu densities to less than 10 palms/hectare. As a consequence of the "ideologization" of land-use strategies, the otherwise symbiotic interactions between pastures and palms, and between ranching and babassu extraction, turn out to be the source of social conflict.

At the other extreme, peasant producers with access to land have increasingly integrated ranching into their livelihood. Small herds of up to a dozen head, but most commonly of just a couple of mixed breed cows, are raised on private or common lands. The main function is to provide cash allotments through the sale of calves (garrotes). Few genetic improvement or breeding programs are offered in the region, and the productive

potential of cows is limited. The production of milk barely supplies local needs. The elimination of juvenile babassu sprouts and invading species (*roço de juquirá*) is the most labor-demanding task in this system. Optimal management requires three cleanings per year, but most pastures receive only one at the outset of the rainy season. Accidental fires occur in the summer, when *jaraguá* pastures are dry. Fire is at times used to control weeds and reinvigorate grass, but burnings are not as ubiquitous as those used for cropping. Images of small-scale cattle ranching in the Mearim Valley are shown in Figure 4-5.



Figure 4-5. Small-scale cattle ranching in Lago do Junco.

Other activities are integrated into the livelihood systems in these communities. Freshwater fishing in streams (igarapés) and reservoirs (açudes) is seasonally critical. Hunting also occurs, although it is limited by the scarcity of game. Small orchards and vegetable gardens are restricted to backyards, except for a few banana producers.

Retirement benefits (aposentadorias) are by far the most relevant sources of monetary income, followed by petty commercial operations in a variety of genres, salaries paid to villagers employed in schools and other offices, and even the earnings of occasional wages. The activities presented in this section, however, are those that more directly affect landscape composition. The manner through which socioeconomic configurations in Pau Santo and São Manoel constrained the performance and integration of these activities, and led to differential land-use/cover trajectories, is examined next.

Ethnography of Resource-Use in São Manoel and Pau Santo

The differential engagement of people in babassu extraction, shifting-cultivation, and cattle ranching has been the proximate determinant of major landscape patterns in Pau Santo and São Manoel. Over time, combinations of these activities, or changes in the way they are integrated, resulted in categories of land-cover that depart from dualistic categorizations such as forested/deforested, or grassland/cropland. Complex and fragmented landscapes emerge in these areas of consolidated occupation characterized by babassu-palm succession, and by large-scale conversion to pasture.

Complex landscapes of the Mearim Valley are not only transitional in terms of vegetation types. They also incorporate in their own structure and composition the feature of “social resilience,” which corresponds to the ability to endure critical transformations but still provide conditions for the livelihood of a wide range of resource-users. Informed by socioeconomic and cultural processes presented in Chapter 3, and by the biophysical

characterization presented earlier in this chapter, in this section I examine the extent of which landscapes in Pau Santo and São Manoel are socially resilient, by looking at the different dynamics of resource-use in these communities. I will focus on the effect of these socioeconomic configurations in shaping the trajectories of local landscapes, mainly after land struggles were over. In this examination, past (pre-conflict) events are presented for the entire region, while current (post-struggle) trends are assessed comparatively for the settlement areas of Pau Santo and São Manoel.

Pre-Conflict Land and Resource-Use

Beginning with the initial establishment of the villages, the first aspect of the biophysical configuration highlighted by narratives is the local perspective concerning the “original landscape.” This includes the perception of predominant land-cover types that were found by those who arrived in Lago do Junco during the period of peasantry formation (1920s to mid-1950s). According to these narratives, people that settled in the area in the late 1940s and 1950s encountered a natural environment that was already different from that found by pioneer settlers of the 1920s and 1930s.

At the time I got here [1936] there was forest, and palms were spread out, some 50 or 100 meters from each other. The fruits of these ‘coringas’ [very tall, old palms] fell within the forest, and were carried away by agoutis. But that was not much. When people began clearing forests, they left not a single palm, cleared everything. Babassu then began to grow, and I still wonder where all those [palms] came from! (Doni Arruda)

I arrived here in 45. Everything was capoeira grossa [advanced second-growth]. There was no primary forest anymore, but there was capoeira grossa, or capoeiruçu, as we use to say. It was land that was proper for working. No one used to talk about ranches, or pastures, nothing. The only thing being spoken about was working. Only work. People thought that if there was no work, no one would live. (José Nogueira)

As seen in Chapter 3, Doni and Nogueira are producers that began cropping the land, and became ranchers in the 1960s. Doni lives in the city and owns land near Pau

Santo, while Nogueira's 200 hectare-property was the largest in post-conflict São Manoel until the time of his death in 2001. Their quotes attest to the fact that babassu stands were not the predominant land-cover up to the mid-1940s. While Doni refers to older palms as part of still existent primary forests, Nogueira indicates that, by 1945, most of those forests were already gone. However, as primary forests were not promptly replaced by pure babassu stands, capoeiruços are still portrayed as species-rich forests.

Alves is another better-off peasant-turned rancher, who lives on and owns 120 hectares in Estirão, near São Manoel. The entire community recognizes him as someone who particularly cares for the environment. Below, he contrasts the composition of today's second-growth forests with the forest before clearing:

The pindovas closed up, they formed a palm-land. Some trees will grow up, but it will not be as before. A lot of those trees are no longer there. In no way it returns as it used to be. I say that because at times my capoeiras were more than 20 years old, and they turned out quite different. Even some trees were different. They do not get back to what it was. (João Alves)

In the Mearim, primary forests had disappeared, as noted earlier by Nogueira, in the process of cultivating annual fields, and not pastures. Alves puts it clearly: "they never cleared forests only for pasture. Pastures were formed only after cropping. That was the way here. The *lageado* was sown on lands cleared for *roça*." Indeed, the clearing of primary forests and capoeiruços in Lago do Junco was almost entirely the result of shifting-cultivation. Forested tracts were, and still today are referred as *terra de trabalho*, or "land to work on." Since that time, the notion that peasants in the Mearim attributed to "doing work," was entirely associated with cropping *roças*, as opposed to raising cattle. As this connotation substantiates, cropping *roças*, raising cattle, and extracting babassu clearly belong to distinct cognitive domains for these people. The only significant case in which another activity circulates through the "work" domain is in reference to land-use

developments in the vicinity of Lago dos Rodrigues. In that location, migrants from a specific region of Ceará, with previous experience in sugarcane cultivation, established and worked on small-scale cane operations. Creating a distinct pattern of land-cover, sugarcane turned out to be the main engine for Lago dos Rodrigues' commercial advantage in comparison to the rest of Lago do Junco. This was noted by a community leader in Pau Santo:

When the forest began to be explored, the Cearenses took over. They were used to growing sugarcane, and they dedicated themselves to that, because there was no forest anymore. A sugarcane industry was formed around Lago dos Rodrigues. There was a lot of cane, a lot of rum, and a lot of rapadura [bars of evaporated cane juice]. Rodrigues was closer to these villages, and more commercial transactions happened there, mainly due to that high production. A trade fair was created, with lots of business. Everyone passed through that fair. Rodrigues grew in population, and in businesses. It was better positioned on the road to Pedreiras. Lago do Junco remained more secluded. People from Junco never produced cane. When the forest was gone, their production was over, too. Up to 1963 cotton was still producing a lot, and many people did well. But cotton trade was finished by 63. They had to rely only on rice, and they cleared all the forest left. Then, the end was to convert it to pasture. But in Rodrigues, in addition to ranching, today they still have sugarcane. It is a permanent source of wealth. (Antonio Batista)

However, as sugarcane remained restricted to a relatively small area near Lago dos Rodrigues, most of the region's mature forests--regardless of whether primary ones or capoeiruços--ended up being cleared as early as by the late 1960s.

Our people were unable to conserve. They did not do as in Pará, where people only clear 50 out of 100 hectares, and leave the other 50 with forest. But our people only wanted to slash and burn. In the first year they cropped here, in the second year a little further, and so on and so forth. I myself was born and raised here. I have seen a lot of forested areas. Those hilltops were all forested. We used to hear howling monkeys. Today the only things we hear are frogs. (João Alves)

In the subsequent period of economic differentiation (from the mid-1950s to the mid 1970s), babassu extraction joined the cropping of roças at the forefront of the regional economy. Combining the activities, peasants consolidated the replacement of

annual crops and fallowed fields for species-rich forests. By then, areas of secondary growth formed by nearly-pure stands of adult palms predominated in local landscapes.

Before, there were no babassu stands, and people used babassu only for local consumption, to make oil for seasoning some game meat. By the 1940s those very tall palms began to be replaced by new, productive ones. Palms spread out, and babassu trade too. (João Alves)

The expansion of babassu as a major land-cover type after the 1950s illustrates feedback effects between socioeconomic and biophysical processes. On the one hand, market incentives and patterns of land occupation allowed the engagement of a massive population in babassu extraction, even assuming a leading role in the regional economy. On the other hand, secondary succession of babassu has critically endowed the region with advantages when compared to other environments. Landscapes filled with babassu's green leaves assumed even mystical features for Northeasterners influenced by the sayings of Ceará's Father Cícero. One of the most notable characters in Brazilian popular religion, Father Cícero implored impoverished peasants to search for green flags (bandeiras verdes) in their journeys to the western lands. In the popular view, these green flags happened to be the large leaves of babassu palms. In fact, as exemplified below, to settle on lands with babassu succession appealed strongly to recently arrived peasants.

I like it here better because babassu provides for the family. There is no way for people to say that they are hungry because they do not have rice. People will not get hungry with babassu. With babassu you can buy rice, you can buy meat, you buy clothes, everything. With a small donkey--as we have--you can even buy furniture for your house, if your family has a plan. Babassu is really important. I am sure I wouldn't be here if there was no babassu. The forested frontier is very good for those who are better off. The others should stay around here. There is no babassu over there, and when rice is over, we are in trouble. (Antonio Vaqueiro)

But if babassu was already taking over the landscape, pastures were not yet widespread in the Mearim. Ranching was a marginal activity in Pau Santo and São Manoel up to the 1960s, being limited to small-scale operations, as exemplified below.

Before 1959, you would buy your cow if you had the means. But they grazed in the bushes, in the forest, like deer, or armadillos. They were fattened only with camará leaves. (Antonio Batista)

Cattle grazed on cotton fields, in the bushes. They ate vines, bushes. They did very well, the capoeira cattle. They did not eat grass, because there was no grass. Only some native milhã grass. Up to the early 60s there was very little pasture. There was more capoeira. When we sowed lageado grass, then the babassu spread even more. (Doni Arruda)

The latter sentence illustrates a critical point for land-use/land-cover dynamics in the region. While dense babassu populations served, and were viewed, as subsidies by peasant producers practicing agriculture, those who were differentiating themselves from the peasant group held a contrasting perspective regarding the palm. Ranchers who began to operate under distinct social and economic norms saw the sprouting and the dominance of a mass of juvenile babassu plants as an additional economic and social burden. Despite the "threat" imposed by secondary succession, pasture formation peaked in the following two decades, the period of social stratification (mid-1970s to late-1980s). Milton, Pau Santo's community leader, compares the two situations:

Up to 1976 there were pastures, but those landowners still had some forested land, because they were smallholders. But then the big ones took over, the wealthy ones. And rich people don't care about roça, they only care about cattle. In 1982, one of them tried to clear the palms within those pastures. In that year we got up, men and women together, and were able to stop that devastation of babassu... But by that time only 400 linhas [130 hectares] were not converted to pasture, including lowlands and hilltops not suitable for cropping. There was pasture everywhere else, and that happened between 1978 and 1985. (Milton Monteiro)

Yet, those were pastures formed with jaraguá grass. And jaraguá pastures were viewed as components of landscapes that could very well be reincorporated in the stock of land for agriculture, particularly if reasonable densities of babassu were left within them. Paradoxically, cattle plays an active role in this operation, as expressed by Lucas, a peasant from Pau Santo who is known for his hard work, but also for his individualistic

attitudes. When asked how long it would take for a jaraguá pasture to be taken over by secondary-growth vegetation and become suitable again for cropping, he states:

It is all about the land. There are stronger and weaker parts. If the land is dry, it takes longer to form, but when the land is stronger, in 10 years it is back. If today, in 2000, you clear [pasture], and you don't clear it any more, you will have it again by 2010. Having cattle grazing on that grass, it will be ready for roça once more in 2010. But if you don't put cattle, then the pasture will be there forever. Because lajeado is disgusting, it is hard to kill. We think it is over, but when we set up a roça, and the rain comes, then it will grow up again! (Lucas)

These were the exact conditions prevailing during land struggles in Pau Santo and São Manoel. At the onset of both conflicts, peasants obstructed pasture clearings while cattle grazed at the ranches. Land turmoil provoked sub-optimal pasture management. This included overgrazing, as cattle stayed longer and at high densities in certain tracts. Sub-optimal conditions for jaraguá grass turned out to be advantageous for capoeiras growing within these pastures. As noted by Lucas, "the capoeira rose because of our struggle!" Later, when they recovered their rights to land, such practices proved to be very useful as a strategy to manage common resources, particularly in São Manoel.

The widespread establishment of pastures also provoked fundamental changes in babassu extraction. After decades of gathering fruits in pastures--as opposed to previous extraction within forests--people changed their perception of the activity. Babassu extraction was since long informed by and adapted to socioeconomic processes affecting landscape configurations. When long-term fallows were possible, the activity was carried out in areas of secondary succession characterized by dense palm stands, and consisted of extraction "within the forest" (coleta no mato). Land privatization and pasture conversion have affected extraction in contrasting ways. On the one hand, the palm became even more critical to the livelihood of dispossessed peasants. On the other hand, arrangements

between landowners (or their agents) and peasants allowed the latter to extract babassu within pastures (*coleta na solta*), although with greater economic burdens to extractors.

Closely following the ongoing changes in land-cover, routines of gathering fruits within more open areas gradually replaced the previous forms of extraction. Years of experienced observation and comparison gained by extraction within pastures changed the perspective of those engaged in the activity. Instead of having their perception of extraction limited to forested domains, they began to notice more favorable conditions in the transformed landscape of palms that grew in association with pastures. The statement below, by one of the peasant political leaders of Lago do Junco, summarizes the issue:

In forested places, babassu produces poorly, it disappears. Production is greater on pastures, because they are cared for. And women are better-off working on open pastures than in forests or *capoeiras*. (José Leopoldo)

In addition to higher productivity of pasture-grown palms, the extraction within pastures was also favored by their proximity to villages, the ease of collection with draft animals, and the relative safety of collection. Kernel extraction can thus occur on more flexible schedules, and in the backyard, instead of throughout long field journeys.⁶

Within closed forests it is worst to carry babassu loads on draft animals. We need to make our way out of the bushes. This does not happen when babassu is inside the meadows. You notice greater production, and it is a more open terrain. You can go on easier, pulling out or riding on an animal. You can't do it within the forest [no mato]. (Raimundo Vital)

Indeed, land struggles of Lago do Junco illustrate that, once accessibility is not constrained and palm fruit gatherers have the option to extract within areas of regrowth,

⁶ Residents of the two communities were asked about their preferred landscape to gather babassu. Almost 94% of the 167 respondents for this question indicated pastures, whereas only 3.5% indicated forested areas (*mato*, *capoeira*), and 2.5% indicated both landscapes. When asked about the preferred site to break babassu, 83% of 180 respondents preferred the house. For breaking (not gathering) babassu, only 17% of the respondents preferred outdoor sites, and all but one respondent in this subgroup preferred the conditions of the shaded, not as hot, forested sites instead of the sunny conditions provided by pastures.

they are more likely to prefer extracting babassu within these pastures. Milton Monteiro clearly contrasts babassu extraction under the two systems:

There was a lot of [babassu] production when we recovered the land. There was almost no forest, just pasture. And babassu produces better when it is cared for. Within pastures there is no fire. When we took over, the land was getting bushes, turning into mato. Then we started to slash-and-burn, and even if we were not clearing everything, fire delays babassu. It would take five years for the palm to bloom again. Then, with all these burnings, fire invades other areas, and this is the worst. Our land has only half of the palms that it used to have. (Milton Monteiro)

Despite growing acceptance of raising cattle among these communities, political conditions that still prevail in rural Maranhão at large make undesirable the deliberate expression by peasant producers of their preference for babassu extraction within pastures. In the confrontational environment of rural Maranhão, babassu extractors that have enhanced their political and socioeconomic condition subordinate their preferences (in respect to the ideal landscape to perform the activity) on behalf of broader negotiations over access rights and control of resources for a more comprehensive social group. In effect, the disparity between practice and discourse related to this preference is overly manifested by the leaders of communities and grassroots movements, as well as by most of the institutions that support their cause, when addressing external audiences. In their discourse in support of the continuity of babassu extraction, these leaders and their supporters condemn cattle ranchers, cattle, and pastures. However, upon their return to the communities, they are confronted with the paradox in the day-to-day decisions and acts of those engaged in babassu extraction, who prefer to perform the activity within palm-pasture associations than in the forested domain. As is examined in the sequence, once land conflicts are resolved, the reversed trajectory towards the elimination of pastures significantly enhanced tensions within communities, and even at the household level. In some instances, when men decide to crop--and eliminate palms from previous

pasture-palms associations--women were set against their own husbands, as they struggled to maintain access to this important source of economic sustenance.

In a more practical sense, although the gathering of babassu within pastures appears to have several advantages when compared to extraction within areas of secondary growth, the effective incorporation of this strategy by peasant producers relies on two basic premises. Within settlement projects and other common areas, land-use planning is required to distinguish between areas for pasture/babassu and those to be used for shifting-cultivation. In addition, peasant producers need to count on their broad and unrestricted access to pastures that contain adequate higher palm densities on nearby, private ranches. Post-struggle developments in Pau Santo and São Manoel were clearly different in this respect, and set into motion rather distinct land-use trajectories.

Land-Use Dynamics in the Post-Struggle: The "Post-Pasture Conversion"

Two apparently contradictory processes comprised the main changes in land-use/cover dynamics of the post-struggle in Pau Santo and São Manoel. The first process is the expansion of the ranching activity among peasants, which is detailed in Chapter 8. The second process is the re-conversion of a considerable amount of pastures to fallow and crops in lands recovered by peasants. This latter transformation, quantified in Chapter 5, has clearly affected the balance between the economic activities of the household, and particularly the role played by babassu extraction. The distinct implementation of this process was key to the different land-cover trajectories and landscape formation in the communities, and particularly in their settlement areas. Being overly influenced by the way human agency and social capital were applied in regulating resource-use, the combination of exogenous factors with particular conditions internal to households and communities of Pau Santo and São Manoel helps to explain these differences.

Land-use trajectories in São Manoel

In the aftermath of São Manoel's struggle, the local association of producers adopted a series of measures targeting land-use planning in the 470-hectare common area. The first initiative was to identify land that should remain under pasture, instead of being redirected to agriculture. People decided to maintain two pasture plots, later subdivided, totaling 75 hectares, or about one-sixth of the settlement area. They opted for the conservation of a forested tract of 25 hectares. The remainder of the settlement area was reserved for shifting-cultivation. Their rationale for land-use is stated below.

When we planned the use of our land, the main aspect considered was distance. We decided to leave pastures near the village because it would be better to care for the livestock. Land further from the village is better for cropping because cattle will not reach there. If we had done the opposite, we would have had to fence all the land for cropping to avoid the entry of cattle. (Raimundo Herminio)

Since the recovery of land rights, annual cropping included the rotation of fairly defined tracts of land, which allowed a 4-year fallow period. Each household continued to individually work and appropriate results of their annual fields, but an agreement at the level of the association stipulated a limit of 1.5 hectare for these fields. Furthermore, to avoid fragmentation, fields began to be installed in those five contiguous areas, as determined each year by the association. Under this system, even though resources were used almost to the limit, rice productivity turned out to be not too inferior to that obtained in areas of greater land availability, but poor planning strategies.

When it is time to crop on one side of the property, everybody crops there. This is why we still have that piece of forest, because with all the difficulty, so far we were able to crop our individual fields side-by-side. Our fields are about 130-140 linhas [45 hectares], and every year we crop them contiguously. This is how we avoided burning the rest of the area. On the day we set fire, everyone attends, and everyone works on fire-brakes. If by any chance fire spreads out, we are all there to control it. So far we have been able to do it. This was very valuable for our land. We were able to educate people, and we have some of the oldest capoeiras in the region. In other settlements we know that it didn't happen in this way. They

start cropping here and there, and they burn a lot of mato. Next year, on another site, and another fire.... There will be a time when there is no land for people to work on. (Raimundo Vital)

Pastures were kept in places closer to the village. More distant ones were used only to reconvert land to agriculture. Indeed, the association rented pastures to outsiders, receiving cash and a share of the steers born on their land. In addition to these payments, the renting of pastures to nearby ranchers served to reconvert the land to secondary growth, through a strategy that skillfully benefited from characteristics of the jaraguá grass. By sustaining an elevated grazing pressure over these areas, settlers effectively reduced the competitive effect of jaraguá grass against the emergent population of juvenile babassu plants.⁷ Although pasture grass was not eliminated from the system, this strategy provided conditions for restoring capoeiras, and after 5-6 years, allowed shifting-cultivation in these areas. Such an outcome was possible because those were pastures of jaraguá grass. A rather distinct trajectory would take place if they were brachiaria pastures, as attested by Antonio, the brother of two settlers, and himself a cattle broker and butcher in São Manoel.

That [brachiaria] grass is not good for our region because it kills all sorts of mato. Even pindovas. There is a site by the road to Paulo Ramos where this grass is well developed, and very tight. Can you believe it has already killed everything? Over there, pindovas will no longer sprout, and there will be only the old palms. In a while it will be worse for us. The little palms are killed and the old ones will fall and die. There will be no babassu production anymore. This grass kills even pindovas that are over 7 feet tall. They start getting yellowish, and then they won't grow anymore. The point is that after killing pindovas, ranchers will have little expenses. And for those who clear pastures, there will be no jobs. (Antonio)

The engagement in livestock provoked mixed feelings in São Manoel after land conflicts ended. Residents viewed cattle as a symbol of the exploitation and suffering

⁷ Walker and Abel (2002:299) examine the process through which sustained grazing pressures on rangelands transform a predominantly grassy ecosystem into a wooded state.

experienced by the community. Yet, because pastures were the predominant land-cover in the post-conflict period, ranching was identified as a practical choice to be integrated into people's livelihoods. Nowadays few people in the community contest the economic benefits acquired through the activity. To summarize, 61% of the settlers (19 out of 31), and 45% of São Manoel's total households (52 out of 116) owned cattle by the year 2000. A total herd of 620 in that year included 172 cattle owned by the 31 settler households (average of 5.5), 40 of which were owned by the producers' association.

Yet, cropping again on lands exposed to over two decades of pastures and cattle herding was not rewarding. To the contrary, people were aware of the lower yields in the initial period. However, this was viewed as a necessary burden in their long-term attempt to reconstruct the place according to their needs. Since most of the settlement area was covered by pasture, they had little choice anyway.

Cattle trampled a lot here. Yields were very small in the first years after we recovered the land. We noticed that the land was too hard, and we knew it was because of all the cattle that were around. (Raimundo Vital)

Resources obtained from pasture rental were used to improve remaining areas and to form their own herd. Rental payments supplemented donations from the Catholic Church, and from a rural credit project, to gradually form a collective herd. Although these cattle were partially distributed among households in 1992, and again in 1999, the association maintained a seed-herd that fluctuates in size, serving also to fund common undertakings. Associates take turns working as caretakers of private and collective cattle on common pastures. By-laws determine that households owning 1, 2, or 3 cattle contribute 12, 18, and 24 days of labor per year, respectively. Those who exceeded should pay a monthly fee, or take their cattle somewhere else. More recently, several associates have been able to purchase small tracts of land in the vicinity for that purpose.

Recovery of land for agriculture and maintenance of permanent pastures were the key components of resource-use planning in São Manoel. Rather than isolated events, the parallel dynamics of land-use and land-cover generated important local knowledge that was used in the subsequent planning by the community, and by individual households.

In these 15 years we realized that babassu production decreases when we leave areas for cropping. Production of babassu rises when in pastures. I was wrong about that. The entire community thought that if we reduced pastures and had more land to work, more forest [mato], the production of babassu would be bigger. But it was the other way around. There is little babassu in these lands because of the yearly fires here and there. And in sites that are not burnt, the palms get tall and slim within the secondary forests. In the long run, babassu production is likely to decrease a lot in lands for cropping. Not because palms are cleared, but because there is a fire every four years. (Raimundo Herminio)

The shifting-cultivation reintroduced in São Manoel's turned out to be socially sustainable (at least relatively speaking) due to three basic conditions that permitted the continuity of babassu extraction. First, a small but still considerable area of pasture was kept in the property, which assured a minimum level of access to babassu stands regardless of people's access rights to other areas. Second, a grassroots movement that pressured for unrestricted access to babassu was centered in and was very successful in São Manoel. And third, medium-sized ranchers in the vicinity shared the perception that the palm was important to households and to the regional economy. Alves exemplifies the latter:

People are crazy who have pasture and clear babassu. By doing so they kill the grass, not only the palm. Palms help those in need. And help the grass, too. They keep it green. There are a lot of things falling from there, and that helps to fertilize. The palm helps to keep moisture on the ground. It is due to palms that we never had a year with no rain. We don't have the forest, but the palms pull the rain down. If you dig a well near a palm, you will find the roots over 50 feet deep. Those tiny roots go far away. I feel bad when I see people clearing palms. I say: don't clear the babassu, just take out some palms if they are too close. Four meters between palms is enough. If the leaves just touch, they don't harm the pasture. It is harmful only when the leaves get intertwined. It is foolish to say that babassu harms pastures, because what it does is to help them. (João Alves)

For over a decade these basic measures of land-use planning served to regulate resource-use in São Manoel, balancing the maintenance of the area's biophysical conditions with household needs, promoting overall socioeconomic improvement. In this manner, the social resilience of landscapes in São Manoel proved to be effective and to reach beyond the settlement area, harmoniously integrating the latter with smallholdings and even medium-size private ranches.

When part of the settlement land was split among 13 of the original settlers in 2001, however, the change represented a concrete threat to previous gains, with effects that still remain to be seen. The 13 plots of 13.5 hectares divided for that purpose constituted 40% of the settlement property. Located further from the village, this land includes the more advanced second-growth forest in the area, part of which had been preserved well before 1987. A considerable part of the area was slashed in the 2001-2002 agricultural year, leaving little hope for the future conservation of the site. Beyond the long-term sustainability of these 13-hectare individual plots, the destiny of the remaining 270 hectares that remain under common property is now at stake. Despite a drop in the number of households cropping this common land, it is reasonable to assume an annual cultivation of 30 hectares of roças. Considering the need for five of such sites in order to provide a 4-year rotation, these 150 hectares, added to the existing area under pasture (75 ha) and the patrimonial land (some 25 ha), will leave very little room for demographic growth, not to mention conservation. Notwithstanding such a somber scenario, previous arrangements and measures taken in São Manoel indicate that, regardless of the means, the community will strive to meet this challenge.

Land-use trajectories in Pau Santo

Resource-management in Pau Santo contrasts sharply with land-use practices carried out in São Manoel. If cooperation and community organization were characteristic of São Manoel, self-interest and conflict seems to be the norm in Pau Santo. The result is that resource-users in Pau Santo failed to take full advantage of the endowments and entitlements that their larger area potentially afforded them. Moreover, current practices seriously compromise future resource-use, which is evidenced by three considerations: first, the lack of land-use planning and its consequences on resource-use; second, the misapplication of resources from projects that targeted land-use activities by the association; third, imbalances in the continuity of babassu extraction within the community. The statement below summarizes the first instance:

There is no plan. Here is for the long-legged [pernalonga]. There are some people that only set their fields in lands with sabiá [a legume tree]. Even if there are only a couple of trees, they go ahead and mark their roças. If they found 20 places with sabiá, then they will have 20 roças. And they don't care about the others. No one has ever asked: hey, fellows, it is May, let us mark our fields together. This does not happen here. When the guy finishes marking his field, he will only care for the one he will crop in the next year. (Antonio Batista)

No management plan is set for the 1,000-hectare property in Pau Santo. Previous attempts by the association to establish common pastures proved unsuccessful. As a result, the overall land-use dynamics in the area include generalized shifting-cultivation, regardless of the site, and most times on fragmented plots. Six or even 7-year fallows are observed, but isolated tracts of land are cropped when they reach this stage, enhancing the risk of accidental fires and reducing the odds for their control. Although land in Pau Santo is cropped after longer fallow periods, the lack of planning combined with the absence of pastures within the area negatively affects household economy. This occurs

mainly through obstacles to the optimal integration of other activities (namely, babassu extraction and small-scale cattle ranching) with shifting-cultivation.

In Pau Santo, 56% of the settler households (28 out of 50) and 34% of total households (38 out of 110) owned cattle in the year 2000. The contrast with São Manoel is evident when one compares total numbers: Pau Santo's herd totaled 156 head, about one fourth of São Manoel's. The 50 settler households owned 116 cattle (average of 2.3), but there are no collectively owned cattle in Pau Santo. If these numbers show a smaller engagement of Pau Santo households in ranching, they also attest to a growing process of informal privatization of common resources, given the absence of collective pastures in the settlement area. Indeed, one of the major complaints among local residents is the uncontrolled enclosure of private plots within common lands, in the last few years.

Although the expansion of such private enclosures is not yet deliberate, the process mimicked at smaller scales certain practices that took place in the 1960s and generated land conflicts in the region. Individuals at first set fences that were said to be temporary, to take advantage of areas with higher concentration of pasture grass that survived the land struggle. A few cattle are raised on those plots with little concern for pasture management. Rather than effectively incorporating cattle ranching into their livelihood strategies, the ultimate concern at this stage seems to have been securing individual tenure rights over the plot. Gradual improvements to such investments involved the replacement of permanent wood poles for provisional ones. Finally, the addition of new barbed wire transformed those land claims into more permanent ones.

Such practices can be viewed as reactions to the frustration and uncertainty faced by a social group that simply did not adjust or did not accept the collective orientations

that are often standard in development projects. Certain groups simply function better if motivated by individualistic goals. This seems to be the case for Pau Santo's settlers, who reproduced the process of frontier expansion within the horizon of their common land. In this case, however, the expansion of a few collides with drawbacks for the others. More striking, such expansion (of economic and agrarian horizons) has been committed through the use of instruments that were acquired to benefit the entire community. Simply stated, for the example under discussion, poles and barbed wire used to enhance private enclosures were largely obtained with rural credit loans to the association of producers, with the goal of installing common pastures.

Besides underutilizing resources for annual cropping, and hampering long-term continuity of mature forests, the lack of land-use planning seriously affects the condition of babassu stands. In the whole settlement area of Pau Santo, these stands do not reach their optimal productive potential. If in São Manoel one-sixth of the original settlement land was kept under pasture/palm association, such a concern did not exist in Pau Santo. Local residents extract babassu outside their land, as pointed out by several interviews.

Almost everywhere is for cropping in this property. Wherever people go there is a roça. People burn everything, and babassu is fading away. Others cut the palms down. It is hard to find babassu nuts. (Dina Santos)

The women leave their own area, here in Pau Santo, to get babassu somewhere else, on lands that belong to ranchers, because there is much more babassu over there. (José Leopoldo)

When I lived in Pau Ferrado, there was an area of pasture we used to call "nursing," it was a source of income for the region. My two daughters used to break 27 kilos of kernels every day, only from that area. Today nobody breaks babassu there, not even one kilo, because they do not care, they are not clearing that land. Now the land is for roça, and they just clear the land to burn it. And this happens everywhere. (Antonio Batista)

Dona Dina, one of the older women in Pau Santo, in addition to complaining about the lack of lands suitable for babassu extraction in her area, touches on a controversial aspect of land tenure recovery in the Mearim Valley. This aspect is particularly pronounced in Pau Santo, as opposed, for example, to São Manoel. The current agrarian configuration of the latter includes several small- and medium-size ranches that surround villages and the settlement area. By granting community access to babassu stands, these landholders allow improved conditions for extraction, and this maintains the resource as a supplement to household livelihood. In Pau Santo, to the contrary, most of the village surroundings are other settlement areas that have also considerably reduced their land under pasture. Most of the ranches and pastures with high-production babassu stands are far away from these villages. Greater awareness and the spread of land struggles around Pau Santo were not accompanied by a parallel strategy for resource-use planning. Therefore, such agrarian developments, in isolation, turned out to generate another dimension of household instability, this time resulting from obstructing optimal conditions for the integration of economic activities, and ultimately affecting the condition of babassu extractors. As Dona Dina puts it:

In Santa Maria there is a lot of babassu because the owner clears the land all the time. Zé Arruda also clears it. But the land here is for roça. There, where Amparo lives, is for roça. At the Centrão is for roça, and over there at São João is for roça. Right there where Zeca lives is also for roça, and all these places used to be pastures where we worked with babassu. I used to break babassu in all those pastures. They were all cleared, only palms. Today there is a village in every one of these sites. Right there in the São Francisco village, before this struggle began, we used to leave home in the morning, to be back only in the afternoon with plenty of kernels in our baskets [cofos]. We spent entire months going there every single day. But not now, because they are using the land to crop roças, and the capoeira rises where there is no roça. You know, those palms are just like crops. They only do well if they are cared for. If you just leave them there, their production will diminish, and they won't produce anymore. We go there but we don't find anything. (Dina Santos)

Batista is a 65 year-old man with health disabilities, who receives social security benefits and has two sons in secondary school. He relies on his children to crop the land. This allows him to reflect on his condition as a peasant cultivator and criticize attitudes and practices of his peers. In his narratives, Batista proposes an alternative land-use strategy that would secure resource optimization in the long run. Curiously, his proposal has many commonalities with recent developments in São Manoel.

By slashing and burning for *roça*, people are burning money. They crop on 50 linhas of palmland, with palms that have four bunches. They have just burnt money. Whatever they produce will not reach what they burnt. Those palms will take five years to restart producing. Five years during which you don't have anywhere to get money, and your crops won't do for even half of your needs. [...] The workers, to care for babassu, they should keep at least a good part of their land to raise livestock. Out of 1,000 hectares, for instance, if we used 300 to raise livestock, then there would be babassu for the future. We would get revenues from cattle, from lambs, from goats, and from babassu. Otherwise, if every corner is to be slashed and burnt, there will be no more babassu. (Antonio Batista)

Land-use/cover trajectories observed in Pau Santo were not consistent with the construction of socially resilient landscapes around contemporary peasant communities in the Mearim Valley. The construction of such landscapes would rely on taking advantage of patterns of natural succession, in the sense that, as seen for São Manoel, these are compatible with the establishment and maintenance of a combination of productive activities by multiple categories of resource-users, even with the restrictions imposed by traditional agro-pastoral/extractive systems. Instead, the internal turmoil that prevailed in Pau Santo during most of the post-struggle era has hampered diversification of activities and channeled available resources to annual cropping, ignoring patterns and processes of the surrounding areas. By giving not only priority, but almost exclusivity to annual cropping, people in Pau Santo have been unable to reconstruct broader socioeconomic and ecological settings that ensure the maintenance of the peasant social system. While

not providing alternatives for a socially sustainable livelihood, land-use practices in Pau Santo turned out to imperil the community's entire socio-natural realm.

Conclusion

Historical developments relevant to resource-use transformations and the dynamic constructions of landscapes in these two communities, from their establishment up to the present day, are summarized in Table 4-2. The table is designed according to the periodization offered in Chapter 3, and is in line with a four-phase cycle, as proposed by Gunderson and Holling (2002).

In general terms, the period of peasantry formation (1920s to mid-1950s) corresponds to the "exploitation" phase in the complex socio-natural ensembles of Pau Santo and São Manoel. In this period, although Maranhenses and migrants from the Northeast had different patterns of interaction with the natural environment, the predominant trajectory of landscape transformation was progressive deforestation for shifting-cultivation, and the consequent conversion of forested land to capoeiruçus, creating conditions for the dominance of babassu in the landscape.

During the period of economic differentiation (mid-1950s to mid-1970s), the incorporation of land for shifting-cultivation continued to be the main feature, but at increased rates and intensities. Primary forests were mostly gone, and after 3-4 cycles of cropping in capoeiruçus and capoeiras, the seed bank of species of the original forest was considerably depleted, which consolidated babassu's hegemony in the landscape. Selective accumulation of resources (capital originated from merchant exploitation, and land that became privatized) opened up prospects for a selected group of producers to further benefit from the labor invested in clearing lands for cropping, and to use this labor to establish jaraguá pastures in those lands, mostly in association with babassu.

Table 4-2. Socio-natural processes, and land-use/cover transformations in Pau Santo and São Manoel (1925-2002)

Period	Peasantry formation 1920s to mid-1950s	Economic stratification mid-1950s to mid-1970s	Social differentiation mid-1970s to late 1980s	Peasantry transformation 1990 to present
Major social processes	Establishment of centres Expansion of freed slaves and descendants Migrants from the Northeast Leveled livelihoods	Land: market integration Better-off peasants became middlemen Departure of initial dwellers (Pau Santo)	Government subsidies Women's reaction against babassu enclosure Church support to peasants	Collective action Producers' associations Party politics Family quarrels
Features of social stratification	Cultural differences: Maranhenses / Cearenses Dependence on city merchants	Capital accumulation by local middlemen Land privatization Extraction of rent	Polarization between ranchers and peasants Contractual access to babassu	Differential inclusion in settlement projects Membership in a broad range of local institutions Social security benefits
Agrarian developments	Lack of landownership Rough landmarks denoting land entitlements Land as common good	Demarcation, sale, and titling of "state land." Illegal "grilagem" Land sales: (SM) internal to villagers; (PS): outsiders	Land concentration Land struggles Settlement projects Collective land-tenure	Delay to begin settlement projects
Main products	Cotton, rice, maize Babassu kernels	Peak period of rice; maize Babassu kernels Cattle	Cattle Babassu kernels Rice, maize, manioc	Cattle Rice, manioc, maize Babassu kernels
Predominant forms of land-use	Crops on forested lands Babassu extraction Use of forest products Hunting + fishing Limited cattle herding	Shifting-cultivation Babassu extraction Expansion of cattle herding	Cattle ranching Scarce land for agriculture Elimination of babassu Land speculation	"Post-pasture" Cattle ranching Shifting-cultivation Babassu extraction
Predominant land-cover types	Mature forest Forest-fallow (capoeiruçu) Cropland Native grassland	Forest fallow (capoeira) Babassu forest (palm-land) Cropland Planted pastures (jaraguá)	Babassu forest (palm-land) Planted pastures (jaraguá) Pasture + babassu Cropland, fallow	Planted pasture (brachiária) Pasture + babassu Cropland Short-fallow

In the mid-1970s to late 1980s, differentiation in the social system turned to pronounced social stratification. The natural system was also marked by intense changes. The increased rate of pasture conversion was accompanied by the adoption of critical pasture management strategies that sealed the opposition between ranchers and peasants. On the other hand, pasture conversion restricted the amount of land left for cropping, and shortened fallow intervals, which limited secondary succession to its initial stage (*capoeira fina*). In addition to the constraints for agriculture, the elimination of babassu palms from pastures, and the replacement of *brachiaria* for *jaraguá* grass in regional landscapes (although the latter was less pronounced in Pau Santo and São Manoel) represented a definite threat for the integrity of both the social and natural systems in Lago do Junco.

The response of the two communities to this threat was an intense process of social mobilization that provoked the “transformation of a peasantry,” a process that could be treated as the “reorganization” phase in Gunderson and Holling’s adaptive cycle. In effect, rearrangements after land conflicts, and the internal challenges presented to local communities are accompanied by reassessments in the role played by pastures, with the likely consolidation of an agro-pastoral/extractive system that balances the maintenance of pasture/babassu associations, in parallel with the re-enhancement of areas for shifting-cultivation under novel conditions. As seen in Pau Santo and São Manoel, the state of harmony or turmoil that characterizes the socioeconomic configuration of a community strongly influences the conditions through which this post-pasture phase is manifested, and the procedures through which the re-conversion of land to agriculture is carried out.

Pau Santo and São Manoel are examples of the range of trajectories peasants can undertake in their quest for continuity and for systems of survival that would improve their livelihood. Although a snapshot taken in the present may indicate that the local environment presents greater integrity in the former, the latter appears to be leaning towards a more sustainable path. Neither case, however, secures the long-term continuity of sustainable agro-pastoral/extractive systems. The maintenance of socially resilient landscapes, indeed, requires a critical management component that, although acknowledged by most resource-users, has seldom been practiced. Antonio Batista, for instance, clearly points out that this practice is necessary to sustain optimal conditions for babassu extraction within pastures. Such an opinion is shared by São Manoel's Hermínio, current president of COPPALJ, the Agro-extractive Cooperative.

The owners cleared the land, cut down half of the palms, and also the pindovas. You know: even if I am old, if I have a grandchild, it will grow up to replace me. Therefore, if there are no pindovas when the old ones fall, there will be nothing to replace them. Those new babassu plants that sprout in these areas, people should take care of them, give them some help strengthen them, so when the old palms are missing, these new ones can take over. (Antonio Batista)

We are concerned. We have no new palms in our and in the neighbors' land. Not within pastures where babassu production is greater. There are no capoteiros. The palms will grow old, and when they all get old, their production will be small. There are lots of pindovas that are cut every year. If some of these were left, then, 10 years from now they would turn to capoteiros, and later to adult palms. By the time they are adult, those old ones will no longer produce. (Raimundo Hermínio)

Despite being critical in the long-term, practices seeking the systematic establishment of new populations of babassu have not yet been carried out in Pau Santo, São Manoel, or anywhere else in Lago do Junco. Babassu palms are not the only component of resource-users' livelihood in the Mearim Valley. Some resource-users are rather opposed to the continuity of these palms. Babassu may not even be critical for biodiversity conservation or fit into prestigious ecological categories. The recent history

of these peasant communities has shown, however, that a concrete socio-natural trajectory to optimize resource-use and address the socioeconomic needs of the community includes the maintenance of palm/pastures associations.

Social and environmental histories of peasant communities in Maranhão have been defined by the combination and shifts in the relative importance of agriculture, ranching and extractive activities. The changing profile of these forms of land-use--and the environmental implications in terms of land-cover--were closely tied to the forms of access to resources and property rights that prevailed in the region, to the character of domestic production in the countryside, to the mobilization of peasant groups, to the response by state agencies and institutions, and to the unique gender relations derived from the babassu economy and that emerged from the struggle for land and livelihood. Ultimately, it was the interplay of such factors that influenced the choice of land-use and management strategies, with significant implications for the sustainability of resource-use, and for the quality of life among people living in Pau Santo and São Manoel.

CHAPTER 5

SENSING LAND-COVER SENSITIVELY: JOINING REMOTE SENSING AND THE ETHNOGRAPHY OF SOCIO-NATURAL CHANGE

The analysis in Chapter 4 portrayed fairly distinct combinations of agriculture, babassu extraction, and cattle ranching in the economic strategies that prevail in Pau Santo and São Manoel. Narratives of residents in the two communities clearly indicated the different trajectories of resource-use they experienced after their struggle for land tenure and property rights in the mid-1980s. Given recent advances in information technology, a natural choice to obtain tangible data that depict landscape change and land-use trajectories is the use of satellite remote sensing and related techniques. Therefore, my general objective in this chapter is, initially, to examine the extent to which the socio-natural transformations taking place in peasant communities in Lago do Junco can be captured by critically employing remote sensing analysis and geographic information systems. The applicability of remote sensing analysis will be tested by comparing land-cover change and resource-use trajectories in the two communities, and among settlement areas and private landholdings in the municipality. While carrying out this local level comparison, I situate and contrast the observed processes of land-cover change with results obtained through broader applications of remote sensing employed in the analysis of deforestation in the eastern Amazon. The comparative approach implies that the instrument of the analysis itself will also be under close scrutiny.

This chapter first explains the objectives and motivations of integrating a remote sensing analysis in this study. Next, it details the methods and procedures employed. The

chapter then presents and compares the results of land-cover classification and land-cover change detection in the communities, and among settlement land and private properties (classified according to size). I assess these findings in light of events on the ground, and compare with results of broader research employing remote sensing. I conclude with a critical examination of the integration of remote sensing and anthropology.

Remote Sensing in the Analysis of Socio-Natural Trajectories

There are two different justifications for the use of remote sensing of satellite images in this research. Coupled with ethnographic fieldwork, the approach is likely to offer unique contributions to the temporal and spatial analysis of transformations in the study area. While I subsequently address these contributions in more detail, there is a different--and in my opinion--prior reason for using the approach. This reason is the need to better inform and adjust the methods and analytical techniques employed in assessments of land-cover change that use satellite remote sensing of fragmented tropical landscapes. I claim that the close examination of transformations in the last two decades in Lago do Junco offers a unique opportunity to refine methodologies used in the remote sensing analysis of land-cover change. These methodological contributions are necessary in areas of consolidated anthropogenic activity in the Amazon characterized by different stages of secondary-growth, and specifically, by palm-fallow^{*} and palm-pasture associations. In these dynamically changing environments, the detailed ethnographic knowledge of the way people use and interact with landscape patterns and vegetation categories are likely to reveal the weaknesses of an approach that fails to consider finer scales. In addition to enhancing the accuracy and reliability of remote sensing analysis of land-cover change, the incorporation of ethnographic data calls attention to the strengths and limitations of the conventional methods.

Need for Refinement and Awareness of Processes Occurring at Local Scales

Instituto Nacional de Pesquisas Espaciais (INPE, the Brazilian National Institute for Space Research) carries out an ambitious effort to monitor deforestation and land-use change in the Brazilian Amazon. Similar studies have been done by international research programs based in the United States. INPE has been systematically monitoring deforestation in Amazonian forests using satellite images since 1988.¹ In the United States, a number of collaborating laboratories and data centers located within the government, universities and the private sector have focused on global change studies,² including extensive research on processes related to deforestation in the Amazon. One of these institutions is the Basic Science and Remote Sensing Initiative (BSRSI³), at Michigan State University. Among other products, BSRSI developed a multi-date region-wide dataset of the distribution of forest, deforestation, secondary growth, and non-forest vegetation in the Amazon.

One of the primary goals of research carried out by INPE and BSRSI (among other similar initiatives) is to measure, estimate, and model the dynamics of deforestation and land-cover change at scales sufficiently broad that the resulting products can serve to

¹ Although INPE's first complete assessment of deforestation in the Amazon covered the 1974-1978 period, annual assessments began in 1988. These activities are part of the Monitoring the Amazon Gross Deforestation Project (PRODES), a project included in the Program of Science and Technology for the Management of Ecosystems, of the Brazilian Ministry of Science and Technology (INPE 2002).

² Several of these institutions are currently integrated within the Federation of Earth Science Information Partners. The Federation was created in 1997 under the auspices of NASA, and brings together government agencies, universities, non-profit organizations, and businesses in an effort to make Earth Science information available to a broader community (<http://www.esipfed.org/>).

³ The Basic Science and Remote Sensing Initiative (BSRSI) is a multidisciplinary collaborative research program in the Department of Geography at Michigan State University focused on global change. The scope of BSRSI spans from local to global analyses of land-use and land-cover change patterns, biogeochemical cycles, and the human dimensions of land-use and land-cover change and global change (<http://bsrsi.msu.edu/>). The Tropical Rain Forest Information Center (TRFIC) is a science data center organized and led by scientists at BSRSI, one of the "information partners" mentioned above.

influence regional and national policies. The achievements of both initiatives have been invaluable in the policy and scientific arenas, and have progressively reached finer applications and smaller scales. However, their monitoring activities consist of analyses that are mainly carried out in large areas. The result is an inevitable loss in detail.⁴

Specific landscapes and types of vegetation that occur in less-familiar regions are likely to be missed, or aggregated into broader, more inclusive categories, particularly when landscape fragmentation is high. It is unlikely, and most often unfeasible to report greatly detailed information in national, sub-national, or even regional level studies. However, this limitation points to a fundamental danger. If the results and knowledge derived from these studies are not contextualized, the findings might be taken as universal truths, and might be interpreted as literal representations of what is taking place on the ground. When the latter happens, the simplified representations of nature have the unintended effect of misrepresenting socio-natural ensembles of people, even entire cultures.

In studies of deforestation and land-cover change, the vast spatial dimensions of a region like the Amazon, and the goal of identifying anthropogenic change, contribute to the tendency to collapse the heterogeneity present on the ground, and reduce the complexity of natural systems. Region-wide assessments of deforestation may require such reductionism. Yet, the coarse grain of such methods is not applicable to the fine grain required by studies of local conditions. The application of what I term “collapsed representations” across scales is unfortunately common in research that employs remote sensing to study land-cover transformations in the Amazon.

⁴ I acknowledge that research agendas of both INPE and BSRSI/TRFIC include thematic areas that focus on local scales and recognize specific human processes and landscape heterogeneity. TRFIC thematic area 2, for example, includes the study of local level causes of land-use/cover change. I contend, however, that their research carried out at larger scales is better funded, more visible and has greater impact.

In all environments, human activity is recognized as a key factor that changes the landscape. Transformations should be seen as the product of interactions among different people in environments with variable natural properties and ecological characteristics. The simplistic distinction between forested and deforested landscapes may be acceptable in regions of more recent anthropogenic activity where colonist farmers clear supposedly undisturbed land for crops and pasture. However, it has to be acknowledged that there exists a vast array of socioeconomic and biophysical configurations that follow paths that are different from the forested/deforested scheme.

This argument is rather complex if we consider the long-term association between forest integrity and the existence of indigenous populations in the Amazon and elsewhere. Indeed, while the limitations of concepts such as pristine forests have been recognized (Denevan 1992, Posey 1989), the notion that still prevails in the characterization of landscapes used and managed by traditional peoples of the Amazon is one in which few differences exist in the structure of standings forests apart from the lowland/upland contrast (Harris 1998). Particularly in areas where the occupation by non-Amerindian peoples is relatively long-term, little credit has been given--in analysis of deforestation and land-cover change--to human-induced changes in the landscape. The latter depiction is precisely applied to areas inhabited by extractive and agro-extractive populations. The work by Brondizio and his colleagues is an important contribution to the ethnographic contextualization of land-use/cover change analysis in Amazonian areas characterized by managed forests of the açai palm (*Euterpe oleracea*), and the extraction of its fruits and palm-heart (Brondizio and Siqueira 1997; Brondizio et al. 1996, 1994). However, little attention has been given to the vast areas covered by babassu palm

forests. In addition to the core area in the states of Maranhão, Tocantins, and Piauí, babassu forests have spread to more recently deforested regions in Pará, Rondônia, and Mato Grosso. Advances in information technology make it increasingly possible to recognize the existence and specificities of human/environment interactions. What seems to be lacking thus far is the effort of more people to focus the available tools and technologies for this purpose.

These issues can be exemplified with the research conducted by INPE and BRSR. INPE's systematic monitoring of deforestation discriminates among thematic classes of original vegetation. As seen in Figure 5-1, INPE classifies most of the north-central part of Maranhão as originally covered by "dense tropical rain forests" and "seasonally deciduous tropical forests." These two classes of vegetation, however, overlap with the area of today's occurrence of babassu forests (marked by the dark oval). In addition to forested formations, INPE's vegetation classes include a few other categories that appear in small portions of the Amazonian territory, such as "early primary succession communities," and "Amazon white sand woodland." There is no reference in INPE's research document, however, to the major pattern of secondary succession in the eastern Amazon, which, since the early decades of this century, has replaced those forests with oligarchic formations of babassu palms. Furthermore, the data produced by INPE estimates that 100,000 km² are still forested in the portion of Maranhão located within the boundaries of the Legal Amazon. My contention is that the area is overestimated. It appears that regions of relatively early deforestation (up to the 1960s), now covered with babassu formations, are being interpreted as primary forests.

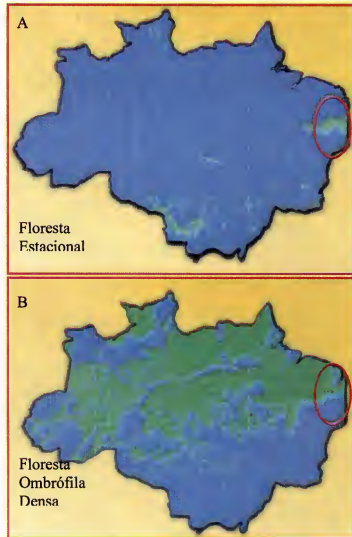


Figure 5-1. Occurrence of selected land-cover types in the Brazilian Legal Amazon. A) Areas of occurrence of seasonally deciduous forest; B) Areas of occurrence of dense tropical forests. (INPE 2002).

Research conducted at TRFIC/BSRSI also used high spatial resolution satellite data to generate forest-cover maps for the Legal Amazon from the 1970s to the 1990s. As for INPE's monitoring endeavor, state- and region-wide digital maps were generated through image processing, careful classification, and subsequent "mosaicking" of 229 Landsat scenes for each period. Classified forest-cover maps were produced for the state of Maranhão for 1975, 1986, 1992, and 1997. Figure 5-2 reproduces 1986, 1992, and

1997 maps for the Landsat footprint (field of view) that includes the Mearim Valley (each Landsat footprint covers an area of 180 km x 180 km).

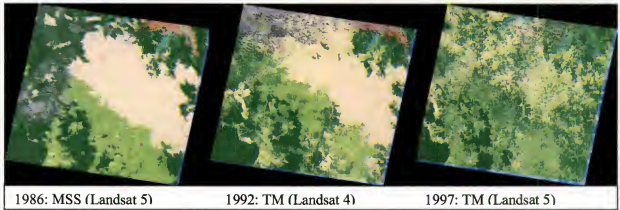


Figure 5-2. Forest cover maps for Landsat scene 221/63. Color correspondence: dark green/forest, light green/secondary growth, beige/deforestation, and brown/cerrado (images reproduced from <http://bsrsi.msu.edu/>).

Compared to INPE's estimates, this sequence of images better represents the forest cover situation of north-central Maranhão. In general terms, the sequence supports my argument for socio-natural transformations in the Mearim Valley in the sense that 1986 marks the peak of incentives for pasture conversion, and the beginning of land struggles that partially transformed resource-use dynamics in the Mearim. Indeed, the most recent image incorporates the effect of tenure recovery and the process of partial “de-pastoralization” that followed land struggles. The decline in pastures is accompanied by an increase in the relative area of secondary growth, and even the reappearance of forests. However, the images are part of a region-wide study, and the choice of categories does not detail the process of primary interest. Hence, a careful examination of this representation raises several issues related to the type of information being provided.

The beige (lighter) area in the 1986 image corresponds to the main region covered by babassu formations in the scene. The entire area is treated as deforested. The area was

indeed subjected to anthropogenic action prior to that time (as were practically all the dark green zones with the exception of those at the left hand side of the scene). However, the on-the-ground situation in 1986 was rather different than the homogeneity depicted in this scene. By 1986, the clearing of primary forests (which in this area occurred prior to the 1960s) resulted in a patchwork of babassu formations of different densities. These patches were either associated with annual crops (shifting-cultivation), other pioneer species in fallow (capoeiras), or pastures of different qualities (jaraguá and brachiária). The same categories persisted in 1992, 1997, and are still found today, although their relative extent has changed. Therefore, even though the simplification portrayed in the 1986 scene ends up being a useful tool to emphasize the social processes addressed in this study, it over-generalizes the information. As a result, the information does not correspond to the situation observed in the field (1986 was the year I arrived and carried out extensive field-work in the Mearim Valley).

If the homogeneity of the lighter portion of the scene actually reflects the “collapsing” trend in deforestation analyses, the same protocols that were applied to interpret the scenes for the other periods produce inconsistent results. The introduction of the “secondary growth” category is certainly an advance compared to INPE’s monitoring of gross deforestation. However, secondary growth in the “babassu zone” was not captured by the analysis in 1986, and only marginally in 1992.

In part, the inconsistency is explained by the fact that the sensor used in 1986 (Landsat Multispectral Scanner, MSS) had lower spatial and spectral resolution than the sensor used to generate the 1992 and 1997 scenes (Landsat Thematic Mapper, TM). While pixel size (spatial resolution) for the latter sensor is 28.5 x 28.5 m (meaning that

the sensor is able to distinguish predominant spectral patterns in an area of 800m^2 , the pixel size for the former was $56 \times 79 \text{ m}$, what increased in more than five times the distinguishable area, to $4,400 \text{ m}^2$. In addition, while image reflectance in the Landsat TM instrument is captured in seven bands (consisting of different wavelength intervals), only four bands were used in Landsat MSS. The sharp contrast between analyses for 1992 and 1997, however, indicate that other factors are also implicated in this inconsistency.

In this particular case, secondary formations of babassu palm can be associated either with crops (under shifting-cultivation), pastures, or, in a later stage, return to forest. Further classification procedures are needed to distinguish among critically different land-cover trajectories, which result from rather different land management strategies. Yet, the visible boundaries among various land-use alternatives in the “babassu zone” become even fuzzier when peasant practices to manage pasture and annual crops are considered. In such cases, the capability of remote sensing to capture important distinctions should be treated with caution. These methodological issues, and the potential utility of remote sensing in discerning among socio-natural trajectories were among the reasons that I incorporated this approach into the present study, as follows.

Identifying Tangible Evidence of Complexity

The combination of accurate and reliable remote sensing techniques with ethnographic research offer important insights by expanding the spatial and temporal breadth of analyses of socio-natural transformations, such as those that occurred in Lago do Junco. A critical aspect is the capability of remote sensing approaches to capture and identify diversity in land-cover. In the specific case of this research, the objective is to go beyond distinctions between forest, deforested land, and areas of secondary growth. The intent is to establish thresholds within expanded but still simple schemes of land-cover

classification that include species-diverse forests, second-growth babassu forests, palm-pasture associations, open pastures, and cropland.

The validity of this scheme will be tested using two different analytical processes. First, the approach will synchronically compare predominant landscape patterns in the two clusters of peasant villages (Pau Santo and São Manoel), and among settlement areas and private landholdings of different size. This examination will provide insights and evidence of whether different management strategies were carried out in Pau Santo and São Manoel clusters. In addition, it will verify patterns of landscape according to the size and type of landholding. Second, an expanded application of satellite remote sensing will involve the longitudinal assessment of land-cover change, or change detection. Land-use dynamics in Pau Santo and São Manoel included a marked shift in the mid-to-late 1980s from the predominant use of pastures, to more diversified economic strategies. As the trajectories of resource-use in the two communities were distinct with respect to the intensity and location of these transformations, remote sensing will be used to verify, measure, and compare changes between 1986 and 2002.

Methodological Protocols and Considerations for Remote Sensing Analysis

The protocols adopted for data collection and interpretation can be divided into four major operations that integrate fieldwork and laboratory analysis, detailed below.

Boundary Maps for Landholdings

Maps of landholdings in the study area were generated by two procedures. A preliminary map was based on field survey of most of the landholdings' boundaries using a Garmin 12XL GPS receiver in August-October 2001. Residents of the communities served as field guides to obtain property boundaries. Four properties were not surveyed because of land conflicts at the time of fieldwork in Fazenda Alegria, between Pau Santo

and São Manoel. In addition, one landholder was opposed to surveying his property. A vector file with GPS points was imported in Imagine 8.5, and served to draw the preliminary map of landholdings. The remaining boundaries were drawn by digitizing an existing 1:30,000 map of landholdings in Lago do Junco/Lago dos Rodrigues, produced by ITERMA, based on 1985 aerial photography. In addition to the 5 missing boundaries in the two clusters, a complete 1985 property-boundary map for Lago do Junco was digitized in ArcEdit 8.2 (Workstation) with a digitizing tablet. The field-based map was then appended to the digitized map. The resulting map included 790 landholdings for Lago do Junco/Lago dos Rodrigues, with 55 in Pau Santo/São Manoel. Landholdings received observation numbers, according to the following categories:

- Ranches larger than 500 hectares.
- Ranches between 200 and 500 hectares.
- Landholdings between 100 and 200 hectares.
- Landholdings between 20 and 100 hectares.
- Landholdings smaller than 20 hectares.
- Settlement areas.

Boundary maps for Pau Santo and São Manoel are shown in Figure 5-3. The complete map of landholdings in Lago do Junco (Figure 5-4), of which only Pau Santo and São Manoel clusters correspond to updated, surveyed information, was used in the analysis of land-cover change across landholding categories.

Collection of Reference Data for Land-Cover Classification

The field collection of ground-cover information is critical to support and test the remote sensing analysis. It was carried out in August-October of 2001, and in June 2002. Field surveys to develop boundary maps were used as additional instances for gathering reference data. The activity included the identification of 180 sample sites for land-cover types of interest, of which geographic coordinates were registered with the GPS receiver.

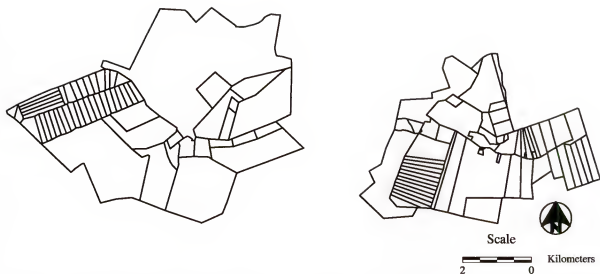


Figure 5-3. Landholdings in Pau Santo and Sao Manoel clusters

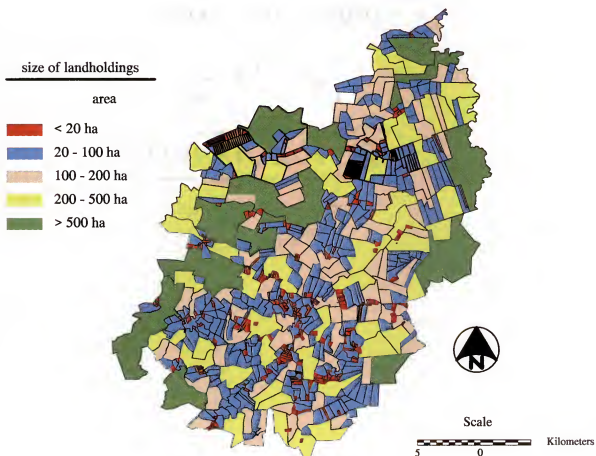


Figure 5-4. Landholdings in Lago do Junco/Lago dos Rodrigues

Each site corresponded to 8-20 pixels in the satellite scenes. Photo documentation and sketch maps were used as backup information, particularly in reference to nearby contrasting land-cover categories. The categories initially considered for data collection are summarized in Table 5-1.

Table 5-1. Classification scheme: land-cover categories for remote sensing analysis

Land-cover category		Sub-category	
I	Species-rich forest	I.1	Gallery forest
		I.2	Upland forest remnants
		I.3	Advanced regrowth (capoeira grossa)
II	Secondary growth/fallow land	II.1	Intermediate regrowth (palm-dominated)
		II.2	Recent fallow (palm-dominated)
III	Babassu-pasture associations	III.1	Jaraguá grass + high palm density
		III.2	Jaraguá + intermediate palm density
		III.3	Jaraguá grass + low palm density
IV	Open upland pasture	IV.1	Brachiária grass (upland pasture)
		IV.2	Jaraguá grass (upland pasture)
V	Open bottomland pasture	V.1	Tango grass, brachiária d'água
		V.2	Hard grass (capim duro)
VI	Cropland	VI.1	Recently slashed (to be cropped)
		VI.2	Harvesting phase (already cropped)
VII	Water streams and reservoirs		
VIII	Villages, roads and bare ground		

These land-cover categories are basically the ones described in Chapter 4, with a few adjustments due to the level of accuracy provided by remote sensing protocols. Category I (species-rich forest) also included gallery forests, and what was designated in Chapter 4 as capoeira grossa (advanced second-growth vegetation). Category II (secondary forest) corresponds to the intermediate and recent phases of second-growth vegetation (capoeira fina) in areas with high presence of palms in secondary succession. The divide between open upland pasture (category IV) and pasture/babassu associations (category III) was established at 25 adult palms/hectare. Pasture/babassu associations were classified according to low, medium and high palm density, with intervals established at 25-50 (low), 50-75 (medium), and more than 75 adult palms/hectare (high). Open upland pastures (category IV) were subdivided between jaraguá and brachiária

grass. Bottomland pastures (category V) were subdivided between grasses locally named tango (and *brachiaria d'água*), and hard grass (*capim duro*). Further identification of categories II to V required surveys to account for babassu populations, including adult and juvenile palms, and stem-less plants (*pindovas*). Two non-vegetation categories were included in the classification scheme: water, including temporary streams and waterways (*igarapés*), and reservoirs (*açúdes*); and gravel roads or bare ground, including village patios and residential areas. The geographic coordinates of water reservoirs in the study area, and the core area of five of the largest villages in Lago do Junco, provided information needed for these categories.

Identification and Acquisition of Remote Sensing Data

Land-cover classification and change detection were based on remotely sensed data obtained from four different dates, and through the use of three data sources:

- Aerial photography, scale 1:10,000, produced in 1985 for ITERMA (Maranhão State Land and Colonization Agency) by a private company (ESTEIO Engenharia e Aerolevantamentos S.A.).
- Multi-spectral Scale (MSS) digital data for 1986 (Landsat 5).
- Enhanced Thematic Mapper (ETM+) digital data for 2000, 2001, and 2002 (Landsat 7). Satellite scenes corresponded to the Landsat Worldwide Reference System 2 (WRS2) path 221, row 63.⁵

Most of the satellite images were acquired in the early dry period (June-August), considered the best time to contrast actively growing forested vegetation and dry pastures (Nyerges and Green 2000: 282). Land-cover classification for 1986 was then compared with the classified scene generated for that year by BRSI/TRFIC. The TRFIC classified scene with forest cover maps was downloaded from their web-site (<http://bsrsi.msu.edu/>).

⁵ Information on the Landsat-7 Program, including information about the Landsat-7 satellite, the ETM+ sensor, and Landsat-7 data collection, is available at the site (<http://ftpwww.gsfc.nasa.gov/IAS/handbook/>).

Remote Sensing Analysis

ERDAS Imagine 8.5 was used for image processing and analysis. Integration of image data and landholdings' property-map used ArcEdit 8.2 and Arc View 3.1. While a detailed description of classification methods is in Appendix C, I briefly summarize the procedures used in land-cover classification, as follows.

The satellite scenes used in the analysis were made compatible through geometric, radiometric, and atmospheric corrections. Initially, the 2001 scene was registered to ground control points obtained with the GPS. The other scenes were geometrically resampled to the 2001 scene, including the MSS scene, which was resampled to 30 x 30 meter pixel size. Radiometric normalization of scenes employed CIPEC protocols (Glen Green, personal communication). Atmospheric effects were controlled through "dark object" subtraction. Figure 5-5 shows the 2001 satellite footprint for the entire 180 x 180 km area, through a color composite combination of bands 3 (red), 4 (infrared), and 5 (mid-infrared), respectively displayed as blue, green, and red color.

The color composite allows the initial identification of broader landscape patterns of areas with low and high biomass, depicted with pinkish (lighter) and greenish (darker) colors. The image is superimposed on a digital map with updated municipal boundaries produced by IBGE (2002). After geometric and radiometric correction, subsets of approximately 2,500 km² (less than 8% of the scenes' spatial extent) were extracted for the area that comprises the municipalities of Lago do Junco and Lago dos Rodrigues. Figure 5-6 shows the subset in 2002, superimposed on the municipal map, and on the map of landholdings in Pau Santo and São Manoel.

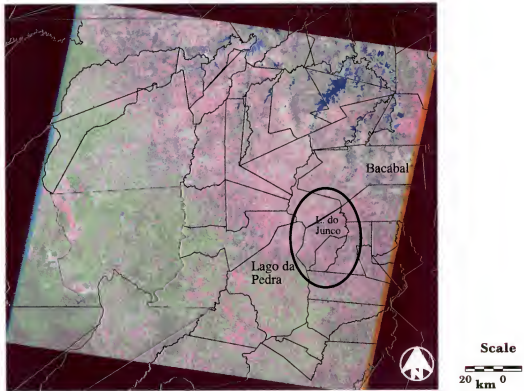


Figure 5-5. Landsat ETM+ composite image (5-4-3: RGB) of Central Maranhao (8.05.2001)

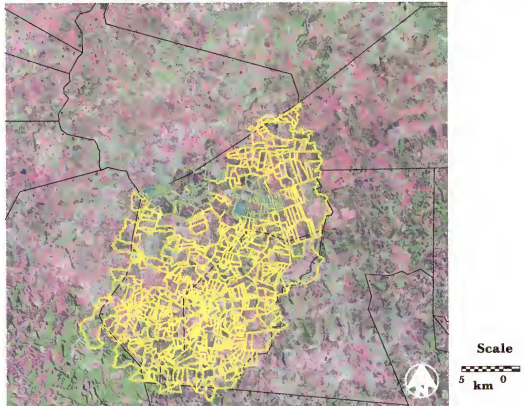


Figure 5-6. Subset of the 2001 RGB image showing landholdings in the study area

Procedures used in the remote sensing analysis formed a hybrid approach between unsupervised and supervised methods. Initially, four sets of supervised classifications were applied to the 2002 scene. The result was a level of accuracy of around 65%.⁶ Supervised classification informed the limited presence of water, and of non-vegetated landscapes (asphalt and gravel roads, urban, villages, dry river banks, and slashed vegetation before cropping), which were all considered as “bare soil.”⁷ Throughout the procedures employed in supervised classification, it also became clear that capturing the spectral distinction between upland and bottomland open pasture, and between cropland, pasture, and bare soil (for recently slashed areas) was beyond the level of complexity carried out in the current study. Even though indicators of class separability (transformed divergence) were satisfactory, I decided to switch approaches and focus on a 6-class scheme that excluded cropland and merged both types of open pastures.⁸

To obtain higher accuracy, I opted for a hybrid method that, although relying on reference information, was based on unsupervised classification. I began with an ISODATA (unsupervised classification), for the identification of respectively 10 (1986) and 8 (2002) land-cover classes. These classified images served as a first “draft” to be assessed through field-gathered reference data (for 2002), and aerial photography (1986). Ninety reference points obtained in 2002, and 190 checkpoints extracted from the 1986

⁶ Classified images were produced according to four algorithms: maximum likelihood, minimum distance, and two parallelepiped methods (overlap by minimum distance, and overlap by order). Accuracy assessment indicated that slightly better results were obtained with the minimum distance algorithm.

⁷ Although I initially considered roads and urban as separate categories, their absence in Pau Santo and São Manoel, and reduced presence for the entire area suggested their inclusion within the “bare soil” category.

⁸ Estimates of cropland were obtained for 2002 through the subtraction of the normalized difference vegetation index (NDVI) for 2002/2001, and 2001/2000. According to these estimates, 4-8% of the land was classified as cropland, with higher proportions for small landholdings. This method could not, however, be replicated for the 1986 scene.

aerial photos were used to identify inaccuracies in the classification schemes. Control points served to identify individual land-cover categories that were likely to be represented by each of the preliminary classes. Although certain classes corresponded to up to four land-cover types, the most common was two categories per class. Subsets for each of the classes were isolated (masked out), and further unsupervised classifications (3-5 classes) were applied to them. The resulting classes were reassessed against control points, and assigned to the six pre-established land-cover types, producing the final maps.

Presentation and Discussion of Results

Comparison between Pau Santo and São Manoel

The 1986 and 2002 land-cover classification maps for Pau Santo and São Manoel are shown in Figures 5-7 and 5-8. Quantitative results are displayed in Table 5-2 and Figure 5-9. The analysis confirmed that landscapes in the mid-1980s were quite similar in the two communities. By 1986, 70% of both areas were converted into pasture. Most pastures were established in association with palms. Forest cover was limited to 10-12%, while secondary formations (indicating areas recently cropped) represented 17-20%. The remote sensing analysis also found that in the next 15 years, the proportion of pastureland in Pau Santo decreased from 70 to 45%, while forest cover increased from 13 to 27%. What in fact took place in Pau Santo was a continuous and cumulative shift among landscape categories: first, babassu palms were left to regrow within open pastures; second, an even greater amount of unmanaged palm/pasture associations were transformed into second-growth; third, this second-growth gradually became forested patches, which were used in shifting-cultivation, and then returned to second-growth. In São Manoel, to the contrary, the proportion of land under palm/pasture association remained unchanged, meaning that similar areas were converted across categories.

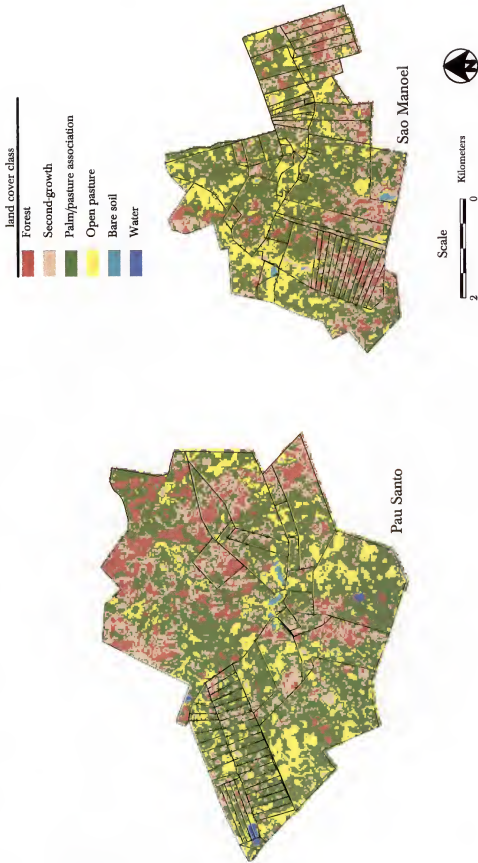


Figure 5-7. Land-cover classification of Pau Santo and Sao Manoel, 1986

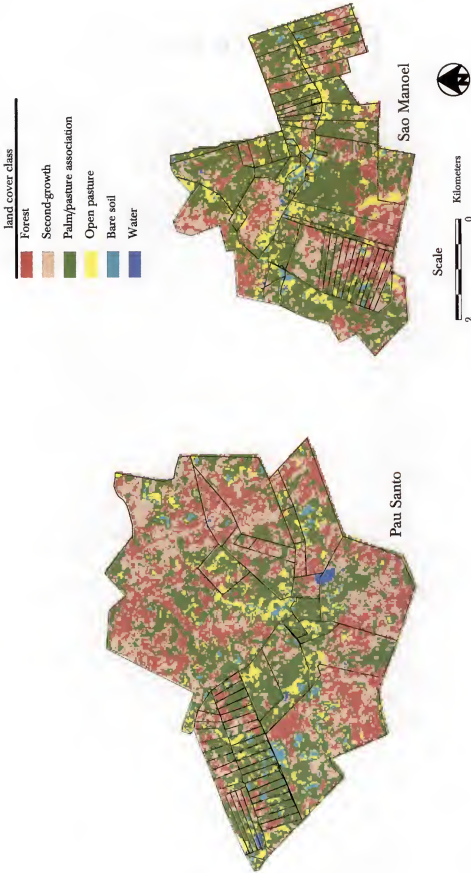


Figure 5-8. Land-cover classification of Pau Santo and Sao Manoel, 2002

Table 5-2. Area and proportion of land-cover classes in Pau Santo and São Manoel

	Pau Santo					São Manoel				
	1986		2002		Δ %	1986		2002		Δ %
	ha	%	ha	%		ha	%	ha	%	
Forest	410	12.9	873	27.4	112.9	198	10.3	342	17.9	73.3
Second-growth	534	16.7	742	23.2	38.9	378	19.7	325	17.0	-13.8
Palm/pasture	1755	55.0	1279	40.1	-27.1	1005	52.5	1002	52.3	-0.3
Open pasture	470	14.7	192	6.0	-59.1	325	17.0	190	9.9	-41.4
Bare soil	14	0.4	90	2.8	545.8	8	0.4	50	2.6	513.3
Water	9	0.3	16	0.5	70.5	1	0.0	5	0.2	750.0
Total	3193		3193			1914		1914		

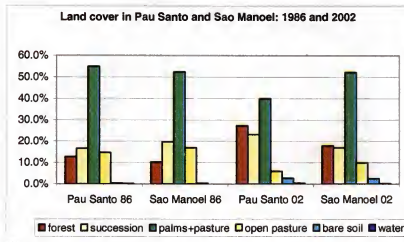


Figure 5-9. Proportion of land-cover classes in Pau Santo and São Manoel (1986, 2002)

These findings are consistent with ethnographic observations. Pastures became less prominent in Pau Santo during this 15-year period, while the peasants in São Manoel increasingly turned to cattle ranching. If we add forest and second-growth, the amount of land potentially available for cropping increased four times more in the former than in the latter. The remote sensing analysis therefore confirms the diverse socio-natural trajectories in Pau Santo and São Manoel: while shifting-cultivation remained the basic and predominant economic activity in the former, ranching and extraction became integrated with annual cropping in the latter.

Comparison among Settlement Areas and Private Properties of Different Sizes

The 1986 and 2002 land-cover classification maps for Lago do Junco/Lago dos Rodrigues are shown in Figures 5-10 and 5-11. Quantitative results are displayed in Table 5-3, and Figure 5-12. The comparison among settlements and private holdings indicates that, while the proportion of forested land in 1986 was quite similar (9-13%, except for the smaller properties), a significant change occurred along the 15-year period. In 2002, almost one-fourth of the settlement land was under forest. This contrasted sharply with private properties, where the proportion under forest did not reach 15%.

Second-growth also increased significantly more in settlement areas, reaching 21% of the land in 2002. In private landholdings, second-growth decreased across all land-size categories. The data show that the proportion of land in forest or second-growth increases from larger to smaller ranches. This trend, however, is sustained only up to the point when property size reaches 100 hectares. Landholdings smaller than 100 hectares presented a decrease in the proportion of land under forest/second-growth. The data suggest depletion of natural resources in areas smaller than 20 hectares. Contrary to other categories that maintained 20-30% of the land under forest or second-growth, landholders in smaller units were able to keep only 14% of the area for these land-cover classes.

An important finding refers to the trajectory of land originally under palm/pasture associations, and open pastures. The land-cover classification for 2002 shows that the proportion of open pastures was significantly lower in settlement areas (8%) than in all private holdings (17 to 23%). Although reaching 42%, the proportion of land in palm/pasture associations is slightly smaller in settlement projects. Indeed, in Lago do Junco's settlement areas, the land covered with palm/pastures slightly decreased (less than 20%), while in all 5 categories of private properties this proportion increased.

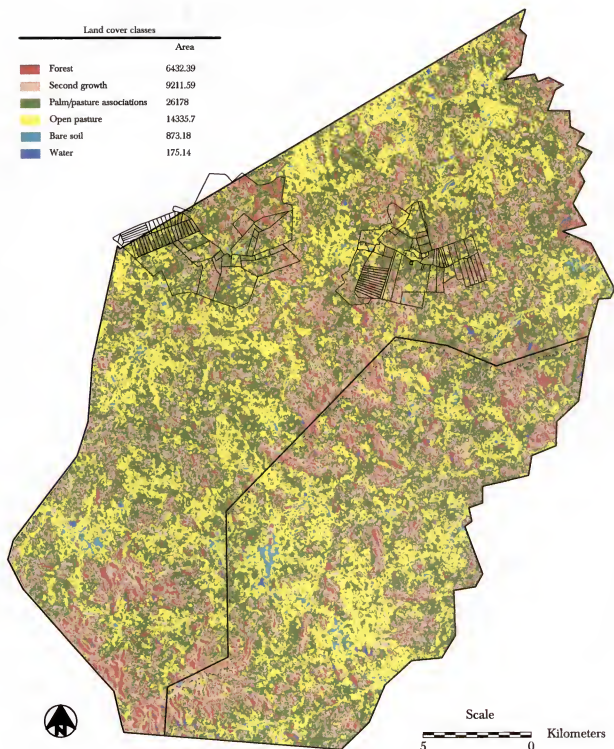


Figure 5-10. Land-cover classification of Lago do Junco/Lago dos Rodrigues, 1986

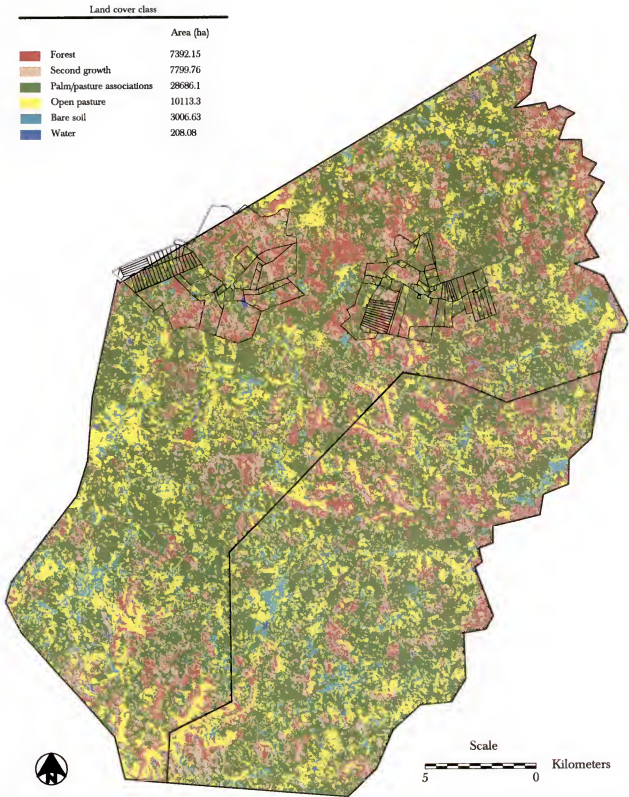


Figure 5-11. Land-cover classification of Lago do Junco/Lago dos Rodrigues, 2002

Table 5-3. Area and proportion of land-cover classes in settlement areas and private landholdings in Lago do Junco/Lago dos Rodrigues (1986, 2002)

Land-cover class	< 20 ha (n=326)					20 – 100 ha (n=313)				
	1986		2002		Δ %	1986		2002		Δ %
	ha	%	ha	%		ha	%	ha	%	
Forest	187	7.1	145	5.5	-22.7	1,950	11.6	1,833	10.9	-6.0
Succession	338	12.9	216	8.2	-36.1	2,905	17.3	2,235	13.3	-23.1
Palm/pasture	1,167	44.4	1,325	50.3	13.5	7,395	43.9	8,554	50.8	15.7
Open pasture	843	32.0	612	23.3	-27.3	4,239	25.2	3,183	18.9	-24.9
Bare soil	92	3.5	328	12.4	258.0	302	1.8	979	5.8	223.8
Water	5	0.2	7	0.3	31.6	47	0.3	56	0.3	18.2
Total	2,632		2,632			16,839		16,839		
Land-cover class	100 – 200 ha (n=87)					200 – 500 ha (n=42)				
	1986		2002		Δ %	1986		2002		Δ %
	ha	%	ha	%		ha	%	ha	%	
Forest	1,576	12.5	1,803	14.3	14.4	1,592	12.3	1,582	12.2	-0.6
Succession	2,417	19.1	1,975	15.6	-18.3	2,192	17.0	1,710	13.2	-22.0
Palm/pasture	5,720	45.3	6,348	50.2	11.0	5,979	46.3	6,638	51.4	11.0
Open pasture	2,732	21.6	1,960	15.5	-28.3	2,957	22.9	2,320	17.9	-21.5
Bare soil	157	1.2	512	4.0	227.0	148	1.1	619	4.8	318.6
Water	39	0.3	43	0.3	10.7	57	0.4	56	0.4	-1.3
Total	12,639		12,639			12,925		12,925		
Land-cover class	≥ 500 ha (n=9)					Settlement areas				
	1986		2002		Δ %	1986		2002		Δ %
	ha	%	ha	%		ha	%	ha	%	
Forest	901	8.6	1,169	11.1	29.8	555	11.8	1,172	24.9	111.1
Succession	1,417	13.5	1,087	10.3	-23.3	719	15.3	982	20.9	36.6
Palm/pasture	4,953	47.1	5,098	48.5	2.9	2,427	51.5	1,973	41.9	-18.7
Open pasture	3,049	29.0	2,499	23.8	-18.0	951	20.2	384	8.1	-59.7
Bare soil	163	1.6	627	6.0	284.4	42	0.9	181	3.8	332.9
Water	23	0.2	26	0.2	15.0	15	0.3	18	0.4	19.2
Total	10,506		10,506			4710		4710		
Land-cover class	Lago do Junco/Rodrigues					Entire scene subset				
	1986		2002		Δ %	1986		2002		Δ %
	ha	%	ha	%		ha	%	ha	%	
Forest	6,432	11.2	7,392	12.9	14.9	29,452	11.5	25,095	9.8	-14.8
Succession	9,212	16.1	7,800	13.6	-15.3	41,416	16.1	28,746	11.2	-30.6
Palm/pasture	26,178	45.8	28,686	50.1	9.6%	112,289	43.7	121,829	47.4	8.5
Open pasture	14,336	25.1	10,113	17.7	-29.5	67,996	26.4	66,045	25.7	-2.9
Bare soil	873	1.5	3,007	5.3	244.3	4,767	1.9	15,985	6.2	235.4
Water	175	0.3	175	0.3	0.0	1,289	0.5	1,353	0.5	5.0
Total	57,206		57,173			257,209		259,054		

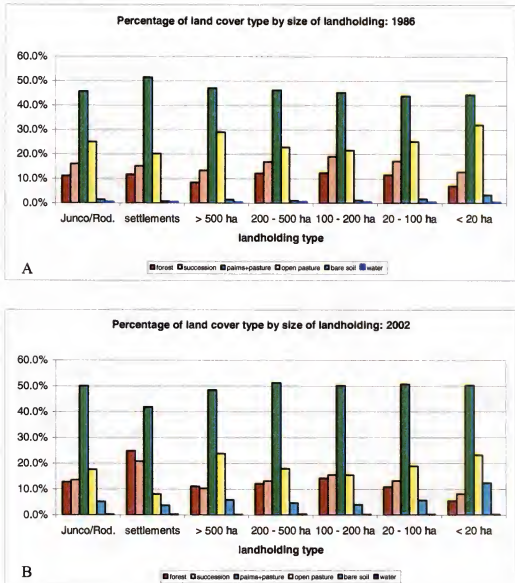


Figure 5-12. Proportion of land-cover classes in settlement areas and private lands in Lago do Junco. A) 1986; B) 2002.

What strikes the attention is the overall decrease of land under open pastures, even among large ranches, and particularly in the settlement areas. The data for the whole municipalities of Lago do Junco/Rodrigues show a 30% decrease in this land-cover category. When we compare these data with a mere 3% decrease of open pastures in the entire scene subset (which includes land in other municipalities), the finding confirms the effectiveness of Lago do Junco's grassroots and social movements. Collective action

achieved the maintenance of babassu palms in the landscape, and provided for peasant access to babassu (“babaçu livre”). In sum, the remote sensing analysis effectively captured the different trajectories that occurred in settlement areas and in private landholdings of different sizes, as well as the unique socio-natural transformations that occurred in Lago do Junco within the Mearim Valley.

Cross-Scale Comparison: When Remote Sensing Gets Closer to Reality

The remote sensing analysis carried out here adopted a simple classification scheme to distinguish among major landscape patterns in Lago do Junco. The approach was based on the careful selection of appropriate information: the definition of classes of vegetation--or land-cover--that are meaningful at the local level. There are several improvements that are certainly needed in the research procedures presented here and in Appendix C. Among these necessary improvements are the spectral separability of cropland, the distinction between upland and bottomland pastures, and higher accuracy needed to distinguish among palm densities in associations with pastures. In addition to palm density, the cleanness of pasture plots (whether juvenile palms and other invasive vegetation are present) also interferes with spectral reflectance. Indeed, these major weaknesses relate to intrinsic features of a landscape that is heterogeneous and fragmented, blurring the boundaries between its components. Yet, I argue that, if cloud-free images are obtained, remote sensing specialist working in interdisciplinary teams will be capable of refining the analytical procedures to capture local variability, and provide a more detailed database for analyses of socio-natural change.

These achievements were beyond the objectives of the present study, which did not include the design and implementation of complex and sophisticated algorithms for land-cover classification. Still, the seemingly simple aspect of selecting the right classes

of land-cover yielded an enormous gain in the quality of the data produced, and expanded the applicability of remote sensing in integrative studies. In order to verify the importance of this simple measure, it suffices to compare land-cover maps presented here, and the general information offered by INPE or TRFIC. Land-cover classification carried out by TRFIC, for example, considered the entire 250,000 hectares of the subset scene as “deforested” in 1986. The application of a finer-grain approach, however, has shown that this area was actually fairly heterogeneous, with important distinctions in land-cover and land-management trajectories. These issues are incorporated in more detail in the conclusion of the chapter, presented next.

Addressing the Integration of Remote Sensing and Anthropological Research

As presented, one of the methodological foundations of this research is the linkage between social and natural sciences. The linkage is accomplished through the integration of fieldwork based on ethnographic investigation and household surveys, with the collection, analysis and interpretation of spatial data obtained with global positioning systems, geographic information systems, and remote sensing techniques. This concluding section explores ethical and epistemological issues applied to the use of these instruments in anthropological research.

According to the opinion expressed by a pioneer in the integration of remote sensing and human ecology research, some anthropologists initially feared the potential competition posed by space-age technologies (Conant 1994:407). Commenting on such integration, Conant concluded that “there is no cause for alarm: the use of satellite data, enhanced by integration of GIS with other information sources, is no threat to fieldwork in anthropology or other field sciences” (Conant 1990:382). Although rightly asserting that such techniques stimulated rather than diminished the need for anthropological

fieldwork, Conant's assessment did not account for the perspective of those whose land is being "sensed," nor did Conant address the problems associated with interpretations that do not necessarily conform to the cultural premises invoked by the research subjects. The growing number of multidisciplinary scientific endeavors in land-use/cover change (LULCC) research indeed has the potential to raise questions of a distinct nature, related to the impact of power relations associated with modern technologies and their effects on the knowledge of local cultures.

There is little doubt that the demand for anthropological expertise in LULCC research is a positive scientific development, as it strengthens (but also safeguards!) the position of science in the face of competing bodies of knowledge. Anthropologists' potential contribution for an optimized use of remote sensing and related technologies encompasses understanding local assessments of land-use and land-cover dynamics, and designing research methodologies that account for cultural factors. Hence, scientific protocols to gather socioeconomic and biophysical data needed for the integration with remote sensing analysis (Moran and Brondizio 1998:99) require the extraction of information from land-users through a combination of field methods. The latter includes household surveys, participant observation, structured and open-ended interviews, and land-use histories derived from walking tours across land-plots.

The very fact that the successful conduct of this line of research builds heavily on reliable data obtained from local informants raises an issue that, if not new in the field of anthropology, deserves the special attention of anthropologists involved in LULCC research. In this regard, a parallel can be traced to traditional ethnographic fieldwork and power relations derived from the ethnographer's monopoly over the process of inscribing

facts (Asad 1984; Clifford, 1984:116-117). However, while in traditional ethnographic investigation the researcher has limited ancillary instruments to crosscheck information provided by interviewees, the character of data provided by remote sensing techniques can generate an even more asymmetric relationship between researchers and informants.

In fact, the contrast between information provided by land-users and data obtained through remote sensing has been recognized as a threat to scientific inquiry in LULCC research (Campbell and Browder 1995:344). This suggests that anthropologists and other social scientists participating in LULCC research should be cautious about the use of such tools. In the end, map-like products can convey "greater truth value than they actually possess" (Conant 1994:410). Guyer and Lambin have correctly noted that anthropological research methods should be supported by ancillary methods, especially where major conditions are changing at the same time (Guyer and Lambin 1993:843). Yet, the participation of anthropologists in LULCC studies should not be limited to the skilled adoption of methodologies based on modern technologies, as implied by Conant's assertion that "anthropologists will become indispensable in the interpretation of satellite products, especially as these relate to non-Western cultural practices ... [once they] become trained in the basics of remote sensing and the kind of measures to be made in the field which are necessary for image interpretation." (Conant 1994:406). I contend that anthropological expertise should go beyond documenting the discrepancy between an interpretation derived from a remotely-sensed image, and the interpretation offered by subjects on the ground. Rather, it should seek an understanding of the contextual and cultural reasons for its manifestation.

More generally, it is apparent that the cultural dimension of land-cover change has been investigated predominantly using the scientific method of hypothesis testing in the positivist methodological tradition. Even the participation of anthropologists in LULCC research has been overly related to behavioral and decision-making studies, and ethnoecological investigations in which resource-users contribute to the classification of landscape features and the characterization of their household, community, or tribe.

Although the contributions of such methodological protocols is not at issue, it is time to integrate a broader range of approaches into this research agenda. The empirical character of LULCC studies does not preclude, for instance, discourse-oriented and interpretive ethnographic work that focuses on the perception of, and on the meaning imputed to, land-use change by human beings in specific settings. Despite the growing number of interdisciplinary teams that focus on the "human dimensions of land-use/cover change," greater attention has to be given to the extent to which the power relations associated with the use of modern techniques interfere with the understandings and transformations of the symbolic dimensions that are invariably part of societies in which land and land-use are embedded in cultural and symbolic systems of local knowledge.

The above argument implies that the epistemological and ethical dimension of the validation of knowledge produced is a major challenge for an expanded incorporation of anthropological expertise in the land-use/cover change research agenda. Indeed, although raising the issue of concrete applications of ethical norms in anthropological fieldwork provokes discomfort and defensive reactions (Fluehr-Lobban 1998:173), it is preferable to preempt such reactions. Paradoxically, addressing such dimensions could be expressed through contrasting perspectives: On the one hand we need additional lines of research in

the LULCC agenda. On the other hand, we need to recognize the importance of domains of knowledge other than the scientific one.

Anthropological studies have shown that non-Western rural communities perceive the natural environment in unique ways (Descola and Palsson 1996; Gudeman and Rivera 1990; Lansing 1991; Strathern 1980; Tilley 1994). People differently experience nature according to the particular social position of the subject, which rests on specific characteristics of the group, and on given historical periods. Constructivist ecological anthropology sees nature as culturally and socially “produced” by coexisting and overlapping regimes articulating their historical and biological perspectives (Escobar 1999). In the context of LULCC studies, therefore, one of the primary objectives of anthropological research would be to focus on the understanding of the mechanisms through which knowledge is produced by, manifested, and perceived within these distinct regimes of nature. For that, anthropologists and the entire scientific community ought to consider the role of representation that operates at the interface between the scientific and subject-knowledge domains. In this sense, Foucault’s treatment of knowledge becomes relevant.

According to Foucault, “knowledge is not an epistemological site that disappears in the science that supersedes it” (1972:184). Rather, “there are bodies of knowledge that are independent of the sciences..., but there is no knowledge without a particular discursive practice; and any discursive practice may be defined by the knowledge it forms.” (1972:183). Considering human sciences in general, Foucault distinguishes three interlocked constituent models borrowed from the domains of biology, economics, and the study of language. Foucault states that the demise of plural representations of (other

bodies of) knowledge took place in the transition from analyses characterized by continuity (models based on functions, conflicts, and significations), to analyses of “positivities” characterized by discontinuity (models based on norms, rules, and systems) (Foucault 1994:356-366).

In ecological anthropology, Rappaport suggested that people’s relation with nature could be expressed through operational and cognized models (Rappaport 1984). While operational models define reality and represent it for analytical purposes according to the researcher’s selective interpretation of what is observed, cognized models are representations of the material and non-material world conceived by those who act in it and which guide their action (Rappaport 1984:237-239). In my view, Rappaport’s cognized models are circumscribed by what Foucault refers to as the historic *a priori*, which provides conditions for the everyday perception and experience of a field of knowledge that acquires theoretical powers (Foucault 1994:158).

Most LULCC studies have been able to grasp the operational model of distinct regimes of nature through empirical observation and measurement of selected entities, and their material relationships. On the other hand, LULCC research has been unable, with notable exceptions of course, to capture key functional relationships present in cognized models, but it also has been unsuccessful in assessing the complex political ecology gravitating around the co-existence of distinct regimes of nature. I argue that the expansion of anthropological expertise is needed on behalf of more complete and convincing explanations, including interpretive studies on functional relationships in the cognized model, and the extent to which changes in such relationships are associated with material manifestations and hierarchical relations in the operational model.

A fundamental aspect of these initiatives is the treatment given to information regarding nature--more specifically, the relationship between the content provided by local informants and the scientific findings derived from modern technology. The use of modern technologies during fieldwork may potentially misrepresent local interpretations of the environment. Indeed, remote sensing and related techniques can be identified as examples of rational instruments of modernity contributing to the "domination of nature" through administrative apparatuses based on expert knowledge (Escobar 1996:55; 1999:6-7), and to the "technologies of power" through which the State constitutes its official subjects (Cohn and Dirks 1988). This directly relates to the power structure and social struggles of most situations being studied through LULCC research. In these situations, indigenous peoples and other rural, non-Western societies have been the ones who historically have retained the knowledge and authority on nature, through discursive constructions, symbolic representations, rituals and myths. Both knowledge and authority constitute critical assets, assuming essential roles for the reproduction of these societies' cultural condition. It is based on this knowledge, for instance, that indigenous peoples and rural communities intellectually negotiate with outsiders. The combination of local information with remote sensing products can eventually result in important findings in the sphere of scientific knowledge and very likely contribute to the mitigation of environmental problems. Even then, necessary conditions for proceeding with such initiatives would be that distinct domains of discourse (Escobar 1996) involved in the practice of these scientific undertakings not undermine the authority of those societies nor compromise the continuity in the generation and transmission of knowledge.

Drawing on my own field experience in the Eastern Amazon and based on my observation of practices and discourses associated with the planning and implementation of research actions by interdisciplinary research teams, I argue that at the pace and with the priorities that most of these investigations have been conducted, there has been little compatibility between their practices and products and the principle of validation of other forms of knowledge. Rather, scientific protocols have been closer to perspectives and operational models of more powerful interest groups such as agro-businesses, corporate ranchers, timber companies, and the State, and their revisited opportunistic discourses.

While dispossessed groups and cultures reveal particular forms of interpretation of nature through unique cognized models and/or cosmologies, I argue that the anthropologist has a key role to perform and an even greater responsibility in reducing the asymmetry predominant in scientific undertakings uncovering such interpretations. Hence, similarly to scientists relying on direct information to understand local representations of nature, those segments remain overly dependent on the “translation” of scientific interpretations of reality provided by remote sensing and other techniques. This translation, however, has not been done properly. Anthropological practice in LULCC research is therefore an appropriate instance to reduce the asymmetry in such relationships, attenuating noises currently blurring such “translations”, and making them more meaningful to local cultures. Growing concern for reducing such asymmetries has to be effectively incorporated into field investigations.

Throughout the study carried out in Lago do Junco, I was able to observe and sense several instances through which the use of relatively sophisticated data collection devices can potentially harm local knowledge and authority, and provoke instabilities

within peasant communities. As noted, I have carried out the present study in sites with which I was familiar since the mid 1980s, those being peasant villages to a great extent already incorporated within processes and mechanisms of the market economy. Still, the disturbing effects that the use of a simple research instrument such as a GPS receiver provoked for those villagers gave me the exact notion of unintended consequences likely resulting from the work of research teams less acquainted with the human subjects of their study, mainly when the latter are experiencing more vulnerable social situations.

I was able to further understand through fieldwork and narratives that communities are formed by groups, households, and ultimately by individuals holding different views and distinct forms of expressing such views. What 15 years ago seemed to me a population holding a uniform standpoint regarding issues of land-use and their relation to the environment, turned out to be a number of competing perspectives, intertwined along different socio-natural domains. Remote sensing techniques are an important tool to capture and better understand such heterogeneity, and this was attested by the findings in this research. It is a sensitive matter, though, and whoever applies the instrument has to be aware of the broader implications raised here.

CHAPTER 6

QUANTITATIVE ASSESSMENT OF RESOURCE-ALLOCATION

In chapters 3 and 4, the analyses of the socio-natural ensembles of Pau Santo and São Manoel were heavily based on my ethnographic interpretation of narratives, which drew on my own situated knowledge of ethnographic details. In Chapter 5, I combined ethnographic observations with the use of remote sensing to analyze land-cover change in the study area. The present chapter assesses Pau Santo and São Manoel in terms of their differential socio-natural trajectories using empirical data and a quantitative analysis of these data. Although recognizing the complexity and multiple domains expressed in the economies of these communities, I argue that quantitative information provides meaningful insights that complement the previous analysis. Analyses carried out in the positivist tradition confer reliability to ethnographic conclusions which, themselves, serve to inform the process of quantitative data collection and interpretation. Hence, it was this integration that allowed me to be ambitious, and to stretch the compatibility between otherwise disparate approaches.

This chapter analyzes the socioeconomic survey that was applied to 226 households in both communities (the survey questionnaire is in Appendix A). I have divided the analysis into two components. In the first component I examine the economic status of households, and scale them up to the community level. In the second component of the quantitative analysis, I investigate the role played by land, labor, and capital in household allocation decisions concerning their investment in agriculture, extractive activities, and livestock herding, or their decision to specialize. For both the components,

I proceeded with the analysis for the total population of both communities, and then compared the results observed in Pau Santo and São Manoel.

Analysis of Socioeconomic Status: Households and Communities

The economic status of households in Pau Santo and São Manoel is not disassociated from the social conditions that mediate the choices and practices involved in resource-allocation strategies. These social conditions are manifested not only at the individual and the household levels, but also at the level of the community. The socioeconomic configurations of peasant communities are shaped by the actions of individual constituents, but also influence their respective socioeconomic outcomes. Through dynamic and interactive processes, different configurations are likely to provoke different resource-allocations by individuals and households, and thereby influence the overall status of a community. In this section, I contend that these heterogeneous social conditions can be assessed by examining the economic strategies of households, scaled up to the level of the community. By comparing the data for Pau Santo and São Manoel, I expect to further support the idea that the cultural constructs that orient the multiple dimensions of social life in these communities produce different socio-natural outcomes.

I begin the analysis by noting the sources of monetary income other than the income from annual crops and babassu extraction. Indeed, Table 6-1 shows that less than one-fourth of revenues in both communities for the year 2000 originated from annual crops and babassu. Comparative analysis of these activities shows that income from babassu was more than three times greater than income from agricultural production. Even after imputing monetary value¹ to the production that is targeted for household

¹ Procedures used to estimate monetary values are in Appendix D. Non-monetary values were based on prices of retail purchase at local stores, and not on values obtained by producers when selling the product.

consumption, "total agricultural income" corresponds to less than one-fourth of all the revenues (monetary and non-monetary) generated in both communities.

Table 6-1. Aggregate income in Pau Santo and São Manoel, 2000 (N = 226)

Activity-source	Pau Santo				São Manoel				Total			
	R\$		n		R\$		n		R\$		n	
			of mi	total			of mi	total			of mi	total
Monetary income (mi)												
Agriculture	17,602	67	7.9	5.3	9,458	66	3.2	2.3	27,060	132	5.2	3.7
Livestock	2,047	21	0.9	0.6	7,976	55	2.7	2.0	10,023	76	1.9	1.4
Babassu	30,218	95	13.6	9.1	60,920	98	20.5	15.1	91,138	192	17.6	12.4
Ranching	7,128	20	3.2	2.2	43,763	50	14.7	10.9	50,891	70	9.8	6.9
Wage labor	12,512	60	5.6	3.8	21,264	57	7.1	5.3	33,776	117	6.5	4.6
Stipend	37,694	25	17.0	11.4	39,625	23	13.3	9.8	77,319	48	14.9	10.5
Social security	95,040	34	42.9	28.8	78,739	26	26.5	19.5	173,779	60	33.5	23.7
Remittances	11,533	25	5.2	3.5	3,082	19	1.0	0.8	14,615	44	2.8	2.0
Commerce	6,594	12	3.0	2.0	21,764	17	7.3	5.4	28,358	29	5.5	3.9
Other	1,399	9	0.6	0.4	10,846	25	3.6	2.7	12,245	68	2.4	1.7
Sub-total (mi)	221,766		100		297,437		100	73.8	519,202		100.0	70.8
Non-monetary income (ni)												
Annual crops	66,552	98		20.1	54,841	101		13.6	121,393	199		16.6
Fruits	9,175	90		2.8	15,658	97		3.9	24,833	187		3.4
Livestock	14,490	92		4.4	17,982	90		4.5	32,471	182		4.4
Babassu	18,516	98		5.6	16,848	79		4.2	35,364	177		4.8
Sub-total (ni)	108,733			32.9	105,329			26.2	214,062	199		29.2
Total	330,499			100	402,766			100	733,265			100

Notes: Data correspond to annual budgets for year 2000, and are expressed in Brazilian currency (as of September 1, 2001, 1BR R\$ = 0.39 US\$)

These preliminary remarks show that peasant producers in Lago do Junco are aware of the limitations of shifting-cultivation imposed by land scarcity. In addition, the findings substantiate the existence of multiple economic strategies pursued by these people to provide for their needs. Indeed, in the year 2000 these households earned an average of approximately R\$2,300 in cash (R\$2,000 in Pau Santo and R\$2,600 in São Manoel). This figure is equivalent to US\$900, or slightly more than one monthly Brazilian minimum wage. The adoption of multiple strategies to access this cash is also verified through another indicator: households obtained their monetary income from an average

of 4.6 sources (4.3 in Pau Santo; 4.8 in São Manoel--with a 1.4 overall standard deviation). Before proceeding with the interpretation of these results, I present the methods used to generate them.

Monetary Income

The household socioeconomic survey (hereafter survey) recorded information on roughly 40 sources of monetary income. These activity-sources were collapsed into 10 major categories. The first category consists of income provided by traditional agricultural products. It includes the sale of annual crops (rice, manioc products, maize, beans, and fava-beans), and the sale of fruits and perennial crops (banana, watermelon, pineapple, and other fruits). The second category entails the sale of small livestock (pigs and poultry) and draft animals (horses, burros, and donkeys). The third category is comprised of the sale of babassu products (kernels, charcoal, and other products), as well as the income received for participation in the agro-extractive cooperative. The fourth category refers to ranching, and includes the sale of cattle and cattle products (milk, cheese, leather), and income received as pasture rentals. The fifth category corresponds to earnings from wage labor, and includes wages earned while working in agricultural undertakings in the community or in neighboring communities, and wages received for work performed in ranches (mostly clearing pastures). The sixth category encompasses stipends that are received on a regular basis. This includes earnings received from working on landholdings in the villages or in villages nearby, as well as income received from employment in the local government or non-governmental organizations, or as seasonal workers in the city. The seventh category refers to retirement benefits, and other payments from the social security system, or other governmental social programs. The eighth category consists of income received as remittances from relatives, and the ninth

category refers to the net revenue obtained from commercial undertakings. The tenth category entails all other sources of monetary income, including, among others, earnings from the performance of specialized work (such as a carpenter, blacksmith, or craftsman).

In July-August 2001, respondents were asked to declare the amount of money received during the previous year for each of these categories. For variables related to agricultural, extractive, and livestock production, the data were crosschecked with information provided in other parts of the survey. Table 6-1 summarizes results at the community level. Table 6-2 presents average results at the household level, and indicates the statistical significance for differences between mean values for the communities.

Table 6-2. Average income for households in Pau Santo and São Manoel, 2000 (N = 226)

Activity - source	Pau Santo			São Manoel			ANOVA significance
	mean	St. dev.	n	Mean	St. dev.	n	
Monetary income							
Agriculture	262.72	(288.79)	67	143.31	(196.67)	66	0.006**
Livestock (no cattle)	97.48	(115.10)	21	145.01	(266.09)	55	0.433
Babassu	318.08	(256.80)	95	576.09	(471.05)	98	0.000***
Ranching	356.38	(206.16)	20	875.26	(1,116.19)	50	0.044*
Wage labor	208.53	(242.73)	60	373.05	(1,815.52)	57	0.488
Stipend	1,507.76	(1,738.46)	25	1,722.83	(1,560.97)	23	0.655
Social security	2,795.29	(1,131.70)	34	3,028.42	(1,302.91)	26	0.462
Remittances	461.30	(595.33)	25	162.21	(133.12)	19	0.038*
Commerce	549.50	(445.97)	12	1,280.24	(1,582.36)	17	0.133
Other monetary	155.44	(249.80)	9	433.84	(661.56)	25	0.231
Sub-total monetary	2,016.05	(1,776.35)	110	2,564.11	(2,759.42)	116	0.079*
Non-monetary income							
Annual crops	605.02	(449.37)	98	472.77	(415.07)	101	0.022*
Fruits	83.41	(92.37)	90	134.99	(219.91)	97	0.024*
Livestock	131.73	(127.92)	92	155.01	(174.33)	90	0.256
Babassu	168.33	(97.09)	98	145.24	(144.85)	79	0.163
Sub-total non-monetary	988.48	(546.07)	110	908.01	(661.22)	116	0.321
Total income	3,004.53	(1,935.61)		3,472.12	(3,134.05)		0.181

*** p<0.001, ** p<0.01, * p<0.10

Interestingly, statistically significant differences between the two communities were found only in the cases of the sale of agricultural products, the revenues provided by ranching, the sale of babassu products, and remittances. Households in Pau Santo have a significantly higher mean income provided by the sale of agricultural products. Average income from ranching and babassu were significantly higher for residents in São Manoel. A statistically significant higher average is reported for the non-monetary income from annual crops in Pau Santo. All other sources of income are not statistically different at the 90% confidence interval. The difference between aggregate mean monetary income in Pau Santo and São Manoel is nearly significant ($p=0.08$). However, average non-monetary incomes in both communities do not depart from chance ($p=0.321$). Statistically significant average differences in the income provided by crops, ranching, and babassu support my contentions that economic activities in Pau Santo tend to focus primarily on the establishment of swidden fields, to the detriment of a more balanced integration of ranching and babassu extraction, the prevailing condition in São Manoel. I will return to this issue in greater detail in the second part of this analysis.

Tables 6-1 and 6-2 highlight the remarkable role of social security benefits in the composition of both communities' revenues. In year 2000, these benefits corresponded to one-third of monetary income received, and almost one-fourth of the overall income in Pau Santo and São Manoel. In Pau Santo, one out of three households had access to this source of income. Every month, the social security system paid a minimum wage (R\$200 in September 2002, or roughly US\$62) to each retiree. In addition to these retirement benefits, the category includes "maternity payments" (accessed through petitions to the social security system), and education payments received by selected families in

exchange for not sending their children to work.² These payments, however, were minor contributions compared to retirement benefits. Yet, even the relatively high monetary amounts provided by the social security system did not affect households' strategy of procuring a diversified source of income. Regardless of receiving retirement benefits, households engaged in the same average numbers of activity-sources to obtain their monetary income (4.6 out of a maximum of 10).

In terms of absolute value, the second most important source of monetary income was the sale of babassu products (95% of which were babassu kernels), corresponding to almost 17% of the total. More important, babassu was included as a source of monetary income in the highest percentage of cases: 192 households, or 85% of the total. The importance of babassu is greater in São Manoel, where its share was over 20% of the monetary revenue. In Pau Santo, babassu's contribution did not reach 14%, and was lower than the amount received from monthly stipends. This finding is consistent with the discussion in Chapter 4, where I have identified the differential treatment given to the extractive activity in the communities, and more specifically, the disregard for the maintenance of ecological conditions for babassu extraction in Pau Santo. The finding is also consistent with the remote sensing analysis that shows greater presence of palm/pasture associations in São Manoel. The revenue provided by ranching acquired statistical significance in São Manoel (15% of the total, in contrast to 3% in Pau Santo). This revenue is almost entirely comprised by the sale of live animals for local slaughter, or sale to cattle brokers. Only 18% of the households in Pau Santo obtained income from cattle, compared to nearly one-half in São Manoel.

² Such payments, named *bolsa escola*, are provided since 2000 by the federal-government Programa de Erradicação do Trabalho Infantil (PETI), the Child Labor Eradication Program.

The importance of babassu sales was nearly matched by salaries or stipends, that corresponded to 15% of the monetary income. As noted, the participation of this item was greater in Pau Santo, where “off-farm” employment was higher. In my field observations, I observed the existence of considerable seasonal urban work in Pau Santo, with established networks for temporary employment in the construction and service sectors of the cities of Belém and Rio de Janeiro. This factor was also responsible for the statistically significant higher amount of remittances received by residents in this community. Regardless of urban stipends, however, both communities included a high number of employees of the municipal government, notably teachers and other workers in the school system, as well as individuals who regularly work for grassroots and non-governmental organizations. The two highest grossing households in this category included a city commissioner, and a director of ASSEMA who works part-time for the institution. Income from steady employment was significantly higher than income from wage labor. However, as expected, the latter was adopted by more than one-half of the households, as opposed to the 20% who have steady employment. Still, the fact that at least one out of each five households in Pau Santo and São Manoel included a member who received a monthly check is impressive. Added to payments received by retirees, remittances, and the profits obtained from commercial activity, these “off-farm” sources of revenue reached almost 60% of the monetary income in both communities. These findings suggest that the stability of these rural communities (such as it is), is largely due to the influx of resources from the outside.

Non-monetary Income

As noted, the low revenue from agricultural products is partially explained by the fact that a considerable proportion of the local production is targeted for consumption. In

an attempt to recognize the contribution of this production, I accounted for the monetary equivalent of items that, to the best of my knowledge, most contributed to the livelihood of peasants in the Mearim Valley. Accordingly, I estimated the monetary equivalents for the annual amounts of the following:

- Rice, maize, manioc, beans, and fava-beans that are produced and not sold by the household.³
- Milk, eggs, fish, swine, and poultry produced locally and allegedly consumed by the household, based on weekly consumption levels reported in the survey.
- Fruits from 12 different fruit trees (orange, lemon, lime, tangerine, mango, cashew, coconut, graviola, cupuaçu, acerola, jackfruit, star-fruit) and from four fruit plants (banana, pineapple, passion fruit, and papaya) that were supposedly harvested and consumed from local orchards.
- Babassu charcoal produced and not sold.

Despite the wide range and the specificities of items produced or extracted, and of incommensurable services that people derive from these items and utilize in their livelihood, this partial list offers important comparative insights into the assessment of economic strategies in Pau Santo and São Manoel.

Aggregate estimates (and the relative contribution of each category), and average household values are presented in the lower sections of Tables 6-1 and 6-2. The comparison of monetary and non-monetary sources of income allows the identification of the average weight of the latter in the composition of a hypothetical “total household annual budget.” For the entire population the proportion was around 30%.

Examining the composition of non-monetary sources of income, it is no surprise that annual crops were responsible for the greatest share of the category (56%). Further examination of this item tells us that, among the range of products, rice (35%) and manioc flour (16%) comprised most of the total. The second most-important item in the

³ The production of manioc flour and beans was estimated according to the reported area cropped.

“non-monetary” category was babassu charcoal, produced by nearly 80% of the households, and therefore accounting for 17% of the “non-monetary” sub-total. The contribution of fruits, livestock products (milk, eggs, pork, swine, and chicken), and locally obtained fish were important to the local diet, and were not negligible in terms of their monetary equivalent. Among these locally produced or obtained sources of protein, freshwater fish was present in the diet of more than one-half of the households. Indeed, I observed that fishing in nearby streams and reservoirs is incorporated into the routine of a significant proportion of local residents. Fishing was often carried out in groups, and served as an important occasion for the maintenance of shared customs and cultural knowledge.

The comparison of “non-monetary” sources of income between Pau Santo and São Manoel shows a similar participation of these items in the composition of household annual budget. The exception was annual crops, which were notably more important in Pau Santo. This factor, associated with the higher level of monetary income in São Manoel, caused households in Pau Santo to have an average higher share of their annual budget derived from “non-monetary” sources (33%, as opposed to São Manoel 26%).

Indices of Socioeconomic Status: Wealth and Well-Being

In addition to measuring household income, the assessment of socioeconomic status in Pau Santo and São Manoel included the calculation of indices based on the ownership or the conditions for:

- Productive assets (livestock: cattle, draft animals, swine, and poultry; pasture; and perennial crops: banana groves, pineapple, passion fruit, and papaya plants, and fruit trees).⁴

⁴ I have purposefully not included “landownership” in the composition of the productive asset index, to avoid biasing subsequent analysis.

- Durable utensils (television, satellite dish, refrigerator, gas stove, bicycle, sewing machine, stereo system, radio, and clock).
- Housing conditions (construction materials, size, electricity, water supply, and sanitation).
- The balance between production, sales, and consumption levels of rice, the most important staple food.

Average indices⁵ for Pau Santo, São Manoel, and the total sample, and the statistical analysis of the variance between means are shown in Table 6-3.

Table 6-3. Indices of socioeconomic status and rice balance in Pau Santo and São Manoel

Indices	Pau Santo		São Manoel		ANOVA significance	Total	
	mean	st. dev.	mean	st. dev.		mean	st. dev.
Socioeconomic status							
Productive assets (PAI)	22.6	(33.6)	65.5	(147.7)	0.003**	44.6	(110.3)
Durable utensils (DUI)	220.6	(204.7)	235.6	(239.4)	0.616	228.3	(222.9)
Housing (HI)	435.0	(127.3)	541.1	(166.2)	0.000***	490.0	(157.6)
Rice balance							
Production/consumption	124	(99)	81	(66)	0.000***	102	(86)
Available/consumption	93	(73)	79	(66)	0.133	86	(69)

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

The calculation of correlation coefficients among these indices, and among them and the estimates for monetary and non-monetary income indicates that all measurements were fairly correlated, and that all correlations were significant at the 0.01 level.

Coefficients oscillated between 0.288 (PAI and non-monetary income) and 0.525 (DUI and HCI). The three indices (PAI, DUI, HI) were more highly correlated to monetary than to non-monetary income. Analysis of variance between means indicates that the

⁵ Figures for the indices should be read as follows. The productive asset index (PAI) and the durable utensils index (DUI) were based upon monetary values of their components, indexed to a maximum value of 1,000. After adding the monetary value of productive assets and durable goods owned by households (according to August 2001 prices), I indexed these values, dividing them by the maximum amount verified for each case. Maximum values for productive assets and durable utensils were respectively R\$35,300 (US\$13,700) and R\$4,800 (US\$1,870), which were indexed to 1,000. The housing index reflects weights given to the 12 constituent items. The maximum index corresponds to a dwelling made of bricked walls, tiles on the roof, cemented floor, measuring 100 m², with 10 internal divisions, latrine, tapped water, water filter, and with electrical power, a porch, a raised garden, and a backyard of one hectare. Rice balance indices respectively correspond to the ratios between the rice produced and consumed in the year (PCI), and between the rice available (rice produced minus sales), and household consumption needs during the year (ACI). Figures are expressed in percentages. The calculation of the indices is shown in Appendix D.

ownership of productive assets, housing conditions, and the ratio between production and consumption of rice in São Manoel were statistically different than the ones in Pau Santo. Conversely, the ownership of durable utensils in the two communities was only different by chance, as was the difference in the ratio between the availability of rice (after sale) and consumption needs ($p=0.133$).

Table 6-3 indicates disparity in the ownership of productive assets between Pau Santo and São Manoel. This mainly reflects the importance imputed to cattle and pastures in the composition of the index, and is consistent with the higher income provided by ranching in São Manoel. Indeed, cattle and (land converted to) pastures are the preferred investments. Except for a few areas that are becoming specialized in banana production, no other item appears to fulfill a similar role in most peasant communities in the Mearim Valley. The index of productive assets (PAI) presents a high degree of concentration, as indicated by lower mean values, and the high ratio between standard deviation and means. High PAI concentration shows that fewer households own the bulk of the assets, in this case, cattle and pastures. Further examination of the degree of concentration for these indices is provided later, using gini coefficients.

Housing conditions in São Manoel are also better than in Pau Santo. This is particularly relevant if we note the considerable proportion of the residents in the latter that benefited from the housing grants that were part of the settlement project, and that automatically raised housing standards. Despite the existence of a few outliers, housing conditions vary less than income and the other indices. The ownership of durable utensils, however, is nearly identical in Pau Santo and São Manoel. The findings indicate that, regardless of their financial situation, productive endowments, and housing

conditions, households in Pau Santo are as determined as those in São Manoel to channel their surplus revenues to appliances and utensils. Compared to productive assets, the ownership of durable utensils is more evenly spread within households. Yet, a reasonable level of concentration in the ownership of these goods (which is slightly higher in São Manoel) is indicated by standard deviations equivalent to the mean values.

The indices for rice indicate that, despite the higher production of this main staple in Pau Santo (evidenced by the levels of monetary and non-monetary income derived from annual crops), households in Pau Santo were forced to sell a larger proportion of the rice otherwise needed for consumption. Considering consumption needs in the community (implicit in the calculations in Table 6-3), shortages of rice amounted to 7%, while annual production was 24% higher than consumption needs. Annual production in São Manoel was, on the average, 19% short of the community's consumption needs. However, São Manoel residents were able to keep nearly all the rice they produced. When considering the price ratio between rice purchased and sold, we conclude that people in São Manoel were more efficient in their market transactions.

Measures of Concentration of Income and Wealth

Further analyses of the concentration or dispersion of income and wealth are provided in Table 6-4 using the gini⁶ coefficient for each of the measures. The analysis of gini coefficients confirms that productive assets was the category with the highest level of concentration (0.721), whereas housing conditions were more similar among the 226

⁶ The "gini Concentration Ratio", or "gini coefficient", measures the proportion of the total area between a diagonal line indicating a condition of equal distribution, and the Lorenz Curve (Shryock and Siegel 1971). The calculation of the Gini coefficient (GI) is based on the formula: $GI_A = (X_i Y_{i+1}) - (X_{i+1} Y_i)$ where " X_i " is the cumulative percentage of the values computed for a variable A, " Y_i " is the cumulative percentage of the number of cases considered for this variable, and " i " is the respective class interval. I computed gini ratios on the basis of 10-class intervals (for each measurement). The intervals for the first and last 3 classes were respectively smaller and larger than the ones for the intermediate 4 classes.

households (0.174). Coefficients for income distribution indicate that non-monetary sources attenuate inequalities in monetary income. The coefficients also show that durable utensils and housing conditions present the most similar patterns of concentration in both communities. Although the differences (between communities) for these categories are small, the gini ratios are slightly higher in São Manoel. Indeed, higher gini coefficients for income (both monetary and non-monetary), and mainly, for productive assets, indicate greater concentration in São Manoel. Taken together, the various indicators reflect a greater degree of economic differentiation in São Manoel.

Table 6-4. Gini coefficients for income levels and indices of socioeconomic status

Category	Pau Santo	São Manoel	Total
Monetary income	0.449	0.481	0.470
Non-monetary income	0.300	0.344	0.325
Total income	0.327	0.386	0.361
Productive assets	0.604	0.734	0.721
Durable utensils	0.506	0.524	0.517
Housing conditions	0.161	0.164	0.174

When these findings are interpreted in the context of the ethnographic data on social relations in Pau Santo and São Manoel, the results pose a critical question for the understanding of socio-natural trajectories and transformations in both places. On the one hand, the somewhat higher monetary income of households in São Manoel, their greater investment in productive assets, and better housing conditions, suggest the pursuit of a trajectory that integrates economic development and environmental sustainability. On the other hand, the fact that all gini coefficients are higher in São Manoel indicates that, perhaps, such positive initiatives are only achievable through greater internal economic differentiation. Before exploring this matter further, I first analyze the weight of selected factors in determining levels of income, wealth, and well-being.

Factors Influencing Income, Wealth, and Well-Being

In order to identify the factors that influenced socioeconomic conditions in Pau Santo and São Manoel, I initially calculated correlation coefficients between selected variables included in the survey, and measurements of income, wealth, and well-being. For categorical variables, I compared the mean values of those measurements for the respective categories. Tables 6-5 and 6-6 display the results.

There is no doubt that the single variable that exerts the greatest effect on the socioeconomic status of households is land tenure. The influence of land tenure can be observed in two ways. First, Table 6-6 shows that the five measurements (with highest statistical significance) gradually increase when comparing the subsets of landless, settlers, and private landowners.⁷ Second, Table 6-5 indicates that privately owned land is highly correlated with all measurements, except non-monetary income. In particular, private land explains more than 80% of the variance in the index of productive assets.⁸

Surprisingly, variables such as education, and membership in local associations or in the agro-extractive cooperative exerted limited influence. Years of schooling for male or female heads of household showed no statistically significant correlation with any of the income and wealth indices. Membership in the cooperative was only significant with respect to housing conditions. Members of producer's associations also performed better in terms of durable utensils and non-monetary income. However, membership in either institution had no statistically significant effect on monetary income or productive assets. In part, this can be explained by the effect of land tenure, as very few of the private

⁷ For this analysis, settlers with an additional private property were considered as private landowners.

⁸ It can be argued, however, that households that had greater income were able to acquire private land, and not the ownership of private land led to higher income.

landowners (who, as just noted, performed better in all categories) were members of these institutions. Indeed, among the private landowners, only those who owned land in addition to being beneficiaries of a settlement project were members of such associations.

Table 6-5. Correlation coefficients between selected variables, income and wealth

Variable		Monetary income	Non-monet. income	Productive assets	Durable utensils	Housing conditions
Age male	cc	.363***	.187**	.193**	.125	.188**
	s	.000	.009	.007	.082	.009
	n	196	196	196	195	194
Age female	cc	.394***	.093	.246***	.203**	.253***
	s	.000	.183	.000	.003	.000
	n	207	207	207	206	205
Education male	cc	-.048	-.087	-.020	.027	-.028
	s	.502	.223	.780	.705	.699
	n	196	196	196	195	194
Education female	cc	-.107	-.099	-.034	.023	-.049
	s	.125	.157	.626	.737	.484
	n	207	207	207	206	205
Size of household	cc	.019	.370***	-.010	.033	.103
	s	.777	.000	.883	.624	.125
	n	226	226	226	225	224
Consumer equivalents	cc	.061	.431***	-.006	.059	.165*
	s	.360	.000	.923	.380	.013
	n	226	226	226	225	224
Consumers/workers	cc	.133*	-.046	.126	-.006	-.058
	s	.046	.488	.060	.924	.390
	n	225	225	225	224	223
Area of private land	cc	.473***	.177	.907***	.594***	.475***
	s	.000	.214	.000	.000	.000
	n	51	51	51	51	51
Size of Annual field	cc	.109	.521***	.026	.144*	.101
	s	.120	.000	.710	.040	.155
	n	203	203	203	202	201
Babassu extractors	cc	.042	.158*	.015	-.044	-.002
	s	.560	.027	.836	.545	.979
	n	196	196	196	195	194
Area of private pasture	cc	-.159	.054	-.159	-.005	-.046
	s	.303	.727	.303	.973	.767
	n	44	44	44	44	44
Years of fallow	cc	-.065	.110	-.055	-.091	.031
	s	.367	.128	.450	.212	.669
	n	193	193	193	192	191
Technology inputs	cc	.142*	.306***	.036	.146*	.023
	s	.033	.000	.591	.028	.729
	n	226	226	226	225	224

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$ (cc=correlation coefficient, s=significance, n=cases)

Table 6-6. Mean values for income and wealth, by categories of selected variables

Variable		Monetary income	Non-monet. income	Productive assets	Durable utensils	Housing conditions
Origin male						
ANOVA significance		0.001***	0.020*	0.706	0.090*	0.119
same municipality	mean	1,612	871	37	195	467
	n	93	93	93	92	91
	st.dev	(1,496)	(490)	(103)	(206)	(159)
other municipality in Maranhão	mean	2,855	1,146	51	273	500
	n	48	48	48	48	48
	st.dev	(3,427)	(825)	(105)	(228)	(150)
other state (Ceará, Piauí)	mean	2,794	1,080	44	249	519
	n	55	55	55	55	55
	st.dev	(2,231)	(550)	(71)	(212)	(150)
Origin female						
ANOVA significance		0.003**	0.824	0.181	0.460	0.080*
same municipality	mean	1,936	962	33	221	485
	n	97	97	97	96	96
	st.dev	(2,480)	(662)	(74)	(213)	(158)
other municipality in Maranhão	mean	2,195	954	66	235	471
	n	66	66	66	66	65
	st.dev	(2,179)	(586)	(170)	(231)	(155)
other state (Ceará, Piauí)	mean	3,399	1,022	47	273	538
	n	44	44	44	44	44
	st.dev	(2,271)	(525)	(75)	(245)	(165)
Membership in association						
ANOVA significance		0.452	0.018*	0.184	0.052*	0.000***
not a member	mean	2,195	865	53	203	445
	n	129	129	129	128	128
	st.dev	(2,723)	(663)	(141)	(227)	(158)
member	mean	2,433	1,057	33	261	550
	n	97	97	97	97	96
	st.dev	(1,721)	(509)	(44)	(214)	(137)
Membership in cooperative						
ANOVA significance		0.551	0.751	0.749	0.429	0.000***
not a member	mean	2,262	942	44	233	475
	n	198	198	198	198	197
	st.dev	(2,416)	(629)	(116)	(225)	(149)
member	mean	2,545	981	51	196	602
	n	28	28	28	27	27
	st.dev	(1,772)	(440)	(60)	(205.26)	(178)
Land tenure situation						
ANOVA significance		0.000***	0.000***	0.000***	0.001***	0.000***
private landowner	mean	3,695	1,165	132	299	606
	n	50	50	50	50	50
	st.dev	(3,542)	(823)	(207)	(269)	(171)
settler	mean	2,268	1,066	26	255	494
	n	86	86	86	86	85
	st.dev	(1,882)	(540)	(33)	(215)	(131)
landless	mean	1,549	713	14	163	421
	n	90	90	90	89	89
	st.dev	(1,393)	(432)	(23)	(183)	(133)

*** p<0.001, ** p<0.01, * p<0.05

The socioeconomic status of the household was associated with the age and origin of the household head, whether male or female. Age is somewhat correlated with monetary income, explaining nearly 15% of its variance: oldest heads of household were more likely to be in households with higher income. Age was also significant if correlated with other measurements, for at least one subset (males or females). With respect to the origin of the household head, the analysis shows that people born in Lago do Junco were worse-off when compared with those born in other places. However, as younger people are more likely to be born locally, one has to be cautious in asserting the importance of place of origin, since younger people tend to have lower incomes.

Another variable affected by age was the size of the household, which proved to be statistically correlated only with non-monetary income. When household size is assessed according to consumption (the calculation of adult equivalents is described in Appendix D), the effect of household composition is even more pronounced.

Other indicators showed only a limited correlation with income and wealth: size of annual field, number of babassu extractors in household, area of pasture, years of fallow, and laborsaving technology. As expected, non-monetary income was associated with annual agricultural fields (+) and with babassu extractors (-). Unexpectedly, the area of pasture did not correlate with productive assets or income. Nor did years of fallow exert an effect on income or wealth. On the other hand, the use of technological inputs (insecticide, herbicide, or mechanization) correlated positively with monetary, and mainly with non-monetary income, as they did with the ownership of durable utensils. Although these latter variables seem to have only limited influence on the socioeconomic

status of the households, they offered important insights for the analysis of trajectories of land-use and allocation decisions by households, to be analyzed next.

Allocation Decisions, Economic Strategies, and Resource-Use Trajectories

The above analysis of annual household income provided strong evidence for the existence of different resource-allocation strategies in Pau Santo and São Manoel. In the remainder of this chapter, I further examine the way households allocate resources among productive activities. More specifically, the objective is to identify the extent to which labor, land, and capital endowments affect people's time investment in shifting-cultivation, babassu extraction, and cattle ranching.

Table 6-7 introduces various measures of economic output in both communities. In order to obtain a more reliable depiction of resource-allocation in Pau Santo and São Manoel, I selected two variables within each of the main activities. Values for annual agriculture refer to the total production of rice, and the size of annual fields (including the area used for other crops: maize, manioc, beans, and fava-beans). Total production of babassu kernels and the number of people engaged in extraction were the variables used to assess babassu extraction. Finally, the size of cattle herds, and the amount of private land converted to pastures were used to assess ranching.

Table 6-7. Outputs of selected economic activities in Pau Santo and São Manoel, 2000

Economic Alternatives	Pau Santo (N=110)			São Manoel (N=116)			ANOVA	
	mean	st. dev.	n	mean	st. dev.	n	F	sig.
Annual Agriculture								
Rice production (kg)	1,422	(929)	97	868	(612)	96	23.8	0.000***
Size annual field (linhas)	4.2	(2.3)	99	2.8	(1.4)	97	25.0	0.000***
Babassu extraction								
Babassu kernels (kg)	696	(550)	94	1,099	(886)	98	10.2	0.002**
Extractors in household	1.8	(1.1)	94	2.3	(1.4)	102	14.2	0.000***
Cattle Ranching								
Size of cattle herd	4.1	(3.9)	38	11.1	(18.0)	52	6.3	0.015*
Private pasture (ha)	4.7	(2.5)	19	22.3	(30.3)	35	5.7	0.020*

*** p<0.001, ** p<0.01, * p<0.05

The data unequivocally attest to different outcomes for all six measurements. The pattern once again supports the contention that annual cropping in Pau Santo is highly important, while ranching and babassu extraction are more significant in São Manoel.⁹ On average, Pau Santo residents produced almost 600 more kilos of rice than those in São Manoel. Rather than higher productivity, the greater production in Pau Santo was, to a large extent, a function of large crop area. In year 2000, rice yields in Pau Santo averaged 365 kg/linha (1 linha = 3,200 m², or approximately one-third of an hectare), just 30 kg more than yields in São Manoel. This difference proved not to be statistically significant.¹⁰ In contrast, the average area cleared in Pau Santo was significantly higher than in São Manoel (4.2 linhas, as opposed to 2.8).

Lower production of rice in São Manoel was compensated for by significantly higher investment in babassu extraction. On the average, households in São Manoel extracted 400 more kg of babassu than those in Pau Santo, in 2000. In addition to a statistically higher average number of extractors per household in São Manoel (2.3) than in Pau Santo (1.8), the data show a higher productivity of labor in the former. On the average, extractors in São Manoel managed to extract and sell 477 kg of kernels per year, one-fourth more than Pau Santo's average of 386 kg. Greater extraction-related labor productivity in São Manoel supports the hypothesis of better conditions for babassu extraction in this community. This, to a great extent, relates to land-use allocations in the community, associated with the significantly higher average area converted to pasture.

⁹ The statistical significance for the difference between average cattle herd and pastures in Pau Santo and São Manoel would be even larger if collective herd and pastures were considered.

¹⁰ Rice yield was computed according to the area of annual fields cropped with rice only, and not with the total area of annual fields presented in Table 6-7. Analysis of variance: $F = 0.461$; $\text{sig.} = 0.498$.

The question that remains is whether the priority given to agriculture was part of a thoughtful plan to restore the livelihood conditions to the pre-conflict period, or rather the result of a failure to adapt to new circumstances. Higher levels of wealth and well-being in São Manoel seem to support the latter interpretation, although the accompanying higher concentration of resources in that community could also explain the strategy observed in Pau Santo. In order to further understand the processes involved, I opted to analyze the relative participation of the three activities in the total allocation of resources by households. This was first done ignoring the community cluster, followed by a comparative analysis of Pau Santo and São Manoel.

Relative Participation of Crops, Babassu, and Ranching in Household Allocation Outputs

In order to assess the relative contribution of crops, babassu, and ranching to household resources, it is necessary to transform the indicators to a common metric. For agricultural and extractive products, I have used their market values (employing the same methods used in tables that reported monetary and non-monetary income). To generate an estimate of income earned from ranching, I used one-fourth of the cattle herd owned by the household, converted to monetary equivalents (using the same method employed to calculate the index of productive assets). These procedures generated a total imputed output from annual crops, babassu extraction, and cattle ranching. Once again, it is worth noting that investment in ranching was underestimated in São Manoel, given the presence of collective herding. The proportion of income derived from each of these activities (expressed as a percentage of the total income from the three activities) is an indicator of the resource-allocation strategies employed by households in both communities.

The various combinations of proportions were considered, and households were then grouped in the categories presented in Table 6-8. The resulting typology identifies

the following strategies: (a) a specialized strategy (households that mainly allocate resources to one activity); (b) a diversified strategy (households that engage in the three activities at levels above a minimum threshold); and (c) a dual strategy (households that allocate resources in two activities, at levels above a minimum threshold). The “diversified” group was further divided according to whether or not one of the activities was “dominant,” (more than 50% of the output). The “dual” group was also subdivided according to the three possible associations: agriculture/extraction, agriculture/ranching, or extraction/ ranching. An additional group was comprised by households that did not engage in any of these strategies, obtaining their livelihood from other sources (such as from wages, stipends, retirements, or remittances).

Table 6-8. Household distribution according to resource-allocation strategy

Category	Pau Santo	São Manoel	Total
Specialized			
Annual agriculture	19	13	32
Babassu extraction	34	33	67
Cattle ranching	2	7	9
Dual			
Agriculture + extraction	31	31	62
Agriculture + ranching	2	0	2
Extraction + ranching	6	7	13
Diversified			
Non-dominant activity	2	8	10
Dominant activity	9	10	19
Other	5	7	12

Note: The threshold for the inclusion of households in the specialized group was 70% of the allocation output provided by the respective activity-source. The minimum threshold to include activities in dual or diversified groups was 10% of the allocation output.

Effect of Land, Labor, and Capital Assets

In addition to grouping households according to their observed resource-allocation strategy, the analysis proceeded by identifying the effect of land, labor, and capital assets on the definition of each major strategy. This was carried out as

follows. Labor assets were assessed by computing adult equivalent-workers (for male, female, and total household members). Land assets were measured according to the amount of private land, and, for households involved in a settlement project, by their (hypothetically defined) share of the common land (estimated by dividing the area of the settlement by the number of families included in the project). Capital assets were assessed by sources of monetary income that were not derived from productive activities. A distinction was made between sources that required the actual engagement in another activity (wage labor, monthly stipend, commerce), and sources of cash that did not demand labor expenditure (retirement and remittances). In addition, the value of capital assets was estimated using the index of durable utensils (productive assets were left out of this analysis because their inclusion would certainly incorporate bias). These nine variables were correlated with the total outcome of annual crops, babassu extraction, and ranching, as well as with the ratio between each activity and total output. The correlations are presented in Table 6-9.

We can interpret the table as follows. The highest correlation was between land and cattle ranching. The most pronounced effect of land was to increase total output, and relative participation of cattle ranching. A clear distinction exists, however, according to whether this land was private, or common property in a settlement project. The large and positive effect of land on ranching allocations was only verified for the former, while increases in the area of "settlement" land were statistically associated with higher allocations in agriculture. Both private and settlement land were negatively associated with the proportion of babassu in outputs, although not necessarily with a smaller output of babassu.

Table 6-9. Correlation coefficients between allocation strategies and factors of production in Pau Santo and São Manoel (N=226)

Variable		Total output			Relative participation		
		agriculture	babassu	cattle	agriculture	babassu	cattle
Private land	cc	-.011	.050	.875***	-.166*	-.221**	.583***
	sig.	.867	.456	.000	.015	.001	.000
Settler land	cc	.201**	-.158*	-.072	.134*	-.144*	.025
	sig.	.002	.017	.281	.050	.035	.716
Total land	cc	.092	-.033	.793***	-.091	-.284***	.570***
	sig.	.169	.619	.000	.183	.000	.000
Male labor	cc	.302***	.288***	-.019	.113	-.102	-.008
	sig.	.000	.000	.780	.100	.137	.907
Female labor	cc	.086	.372***	-.058	-.144*	.191**	-.083
	sig.	.196	.000	.385	.035	.005	.229
Total labor	cc	.244***	.395***	-.045	-.006	.039	-.051
	sig.	.000	.000	.504	.926	.566	.455
Cash 1: work demand	cc	.141*	.094	.221**	.025	-.116	.142*
	sig.	.034	.161	.001	.715	.091	.038
Cash 2: no work	cc	-.011	-.228**	.103	.016	-.163*	.227**
	sig.	.869	.001	.122	.813	.017	.001
Capital assets	cc	.108	-.067	.407***	-.013	-.207**	.337***
	sig.	.107	.315	.000	.852	.002	.000

*** p<0.001, ** p<0.01, * p<0.05

The effect of "labor" revealed a clear gender component. The availability of female labor in the household was statistically correlated with greater contribution of babassu extraction in household outputs. Availability of male labor, on the other hand, despite increasing total from extraction, tended to negatively interfere with the relative importance of babassu in total outputs. Male labor was also correlated with greater agricultural production, although this correlation was not transferred to the participation of crops. The effect of female labor in agricultural outputs was analogous to the one male labor exerted in extraction. Finally, labor availability seems to have little effect in ranching allocations. If any association is verified at all, it was negative.

With regard to the effect of cash and capital assets, the data indicate a strong positive correlation between greater capital availability and enhanced participation in ranching, as well as the inverse effect in babassu extraction. It is worth noting, however,

that the effect of cash availability is more pronounced when derived from sources that did not demand labor expenditures. Further examination of the effect of means of production in the definition of allocation strategies is provided by the following regression analyses.

Regression Analysis of Economic Outputs on Factors of Production

To compare the effect of land, labor, and capital in allocation strategies, I regressed the total output (expressed as a monetary equivalent) of crops, babassu, and cattle, as well as the proportion that these outputs represented in total income, on selected variables (from Table 6-9). Single variables did not always prove to be simultaneously correlated with measurements of absolute outputs, and with relative outputs, for all the strategies being considered. Therefore, when regressing total and relative output for each of the activities, I selected the variables from Table 6-9 with higher correlations with the respective activity. For example, in some instances the availability of cash from stipends and wages was the “capital” variable used to regress total outputs, while the index of durable utensils was the variable used to regress relative outputs. Below, I present the regression analysis for each case.

Effect of land, labor, and capital on crop output, and on proportion of crops in total output

Table 6-9 indicates that, among the three factors of production, labor was the most relevant to higher output for crops, although the effect proved to be limited for the relative participation of crops in the overall output. The upper portion of Table 6-10 indicates that the total quantity of labor explains 6% of the variance in agricultural output. Each additional adult-equivalent labor unit was associated with an increase in annual monetary-equivalent of R\$94.53.

Table 6-10. Regression of crop output, and proportion of crops on land, labor and capital

Crop output	Model 1a	Model 1b	Model 1c	Model 1d	Model 1e
(constant)	238.75	179.69	153.39	174.87	150.81
independent variables					
male labor	--	--	--	158.15	160.18
female labor	--	--	--	-2.72	-1.66
total labor	94.53	87.90	85.12	--	--
private land	--	--	--	-0.16	0.10
settlement land	--	9.92	10.11	8.86	7.29
capital: cash income	--	--	0.052	0.046	0.046
community cluster	--	--	--	--	62.49
r ²	0.060	0.092	0.109	0.128	0.130
F	14.23	11.24	9.07	6.48	5.47
sig.	0.000***	0.000***	0.000***	0.000***	0.000***
Crop proportion	Model 2a	Model 2b	Model 2c	Model 2d	Model 2e
(constant)	32.51	33.39	35.71	37.81	36.02
independent variables					
male labor	--	--	--	5.35	5.50
female labor	--	--	--	-8.07	-7.98
total labor	--	-0.45	-0.66	--	--
private land	--	--	-0.28	-0.27	-0.26
settlement land	0.42	0.43	0.34	0.24	0.12
capital: cash income	--	0.0006	0.0017	0.0009	0.0009
community cluster	--	--	--	--	4.64
r ²	0.018	0.019	0.045	0.086	0.090
F	3.93	1.36	2.44	3.93	3.40
sig.	0.05*	0.256	0.048*	0.002**	0.003**

The quantity of settlement land in regression model 1b explained an additional 3.2% of the variance. Controlling for labor allocations, the annual output from crops increases by R\$9.92 for each additional hectare. Given the size of hypothetical land shares in the settlement areas of Pau Santo (24 ha), São Sebastião (17 ha), São Francisco (27 ha), São João (13 ha), São José (11 ha), and São Manoel (14 ha), this represents additional monetary-equivalents in the range of R\$109 to R\$268. By adding capital to model 1c, the model explains an additional 1.7% of the variance in the output of crops, reaching a total of 10.9%. This can be interpreted as follows: once land and labor are considered, the monetary equivalent of a crop's output will increase by R\$5.20 for each R\$100.00 that are available to the household from payments for activities that demanded

labor expenditure. Model 1d distinguishes between male and female labor, and between private and settlement land, explaining 12.8% of the variance in crop output. The coefficient indicates that, although each male adult-equivalent unit increases total output by R\$158.15, this increase is partially offset by the negative effect of female labor (a decrease of R\$2.72 in total output for each female adult-equivalent unit). Similarly, the model predicts that the incorporation of private land will decrease agricultural output by R\$0.16 for each hectare, assuming that settlement land is available. In this model, the effect of capital remains practically unaltered. Finally, the effect of community cluster is incorporated in model 1e (São Manoel is the reference category). The distinction between communities only adds 0.2% in the explanation of variance, bringing the total to 13%. However, the model predicts total output from crops will be R\$62.49 higher if a household is from Pau Santo. In addition, adding the “community” effect to the model attenuates the negative impact of female labor, and turns the effect of private land from negative to positive.

In the lower part of Table 6-10, the proportion of crops in total output (expressed as a percentage) is regressed on the same variables as the upper panel. The smaller effect of the variables, and consequently the lower predictive power of the models are reflected in the lower r-squares, F-values, and level of statistical significance. The variable that, by itself, predicts the highest amount of variance is the quantity of settlement land. Although explaining only 1.8% of the variance, model 2a increases by 0.42% the relative participation of crops in total output, for each hectare of settlement land available to households. As the constant value for model 2a is 32.51%, the predicted proportion of crops in the total output for families in settlement projects ranges from 37% in São José,

to 44% in São Francisco. The incorporation of labor and capital in model 2b adds only 0.1 to the percentage of variance explained. The model shows a negative effect of total labor (a decrease in 0.45% in the proportion for each adult-equivalent unit), and a limited effect of capital: the proportion of crops in totals output increases by only 0.06% for each R\$100.00 earned by the household during the year as wages, stipends, or salaries. Model 2c incorporates private land, which has a negative effect on the proportion of crops (a decrease in 0.28% for each hectare). This means that, for a household included in São Manoel's settlement area, with 2.5 adult equivalents and annual earnings of \$600, and which gains access to an additional private property of 20 hectares, the predicted proportion of crops in total output will be 39.28%. The proportion predicted for the same household by models 2a and 2b would be of respectively 38.39% and 38.65%. Model 2d distinguishes between male and female labor, increasing the percentage of variance explained to 8.6%. Similarly to crops output, model 2d predicts that each male adult-equivalent unit increases the proportion of crops in outputs by 5.35%, while a decrease of 8.07% is predicted for each additional female adult-equivalent unit. For the household used in the above example, if the 2.5 labor units were formed by 1.5 adult-male and 1.0 adult-female equivalent, the proportion of crops will be 41.12%. If the labor units were 1.5 female and 1.0 male, model 2d predicts a proportion of crops of 34.41%. Model 2e, by adding the community effect, increases the explanation of variance to 9%. The model predicts that, once controlling for land, labor, and capital endowments, the proportion of crops in total outputs in Pau Santo will be 4.6% higher than in São Manoel.

Effect of land, labor, and capital on babassu output, and on proportion of babassu in total output

The quantity of labor was an important predictor of babassu output. Model 3.a includes indicators of both male and female labor, explaining 16.5% of the variance. For each additional female adult-equivalent unit, the model predicts that the annual monetary equivalent of babassu output increases by R\$169. The annual predicted increase brought by an additional male-equivalent unit was R\$83. The gendered character of babassu extraction is clearly confirmed by these findings.

Table 6-11. Regression of babassu output, and proportion of babassu on total output on land, labor and capital

Babassu output	Model 3a	Model 3b	Model 3c	Model 3d	Model 3e
(constant)	191.43	242.28	275.25	270.62	315.23
independent variables					
male labor	83.52	100.47	103.39	104.48	100.81
female labor	169.30	160.73	159.72	161.17	159.37
total labor	--	--	--	--	--
private land	--	--	--	1.87	1.41
settlement land	--	-8.29	-8.10	-7.40	-4.43
capital: utensil assets	--	--	-0.158	-0.22	-0.23
community cluster	--	--	--	--	-116.32
r ²	0.165	0.199	0.205	0.210	0.221
F	22.06	18.42	14.19	11.66	10.29
sig.	0.000***	0.000***	0.000***	0.000***	0.000***
Babassu proportion	Model 4a	Model 4b	Model 4c	Model 4d	Model 4e
(constant)	48.36	50.77	53.55	56.77	56.50
independent variables					
male labor	-6.76	-6.03	-6.24	-6.18	-6.15
female labor	10.71	10.31	10.37	9.89	9.90
total labor	--	--	--	--	--
private land	--	--	--	-0.39	-0.38
settlement land	--	-0.477	-0.316	-0.46	-0.47
capital: cash income	--	--	-0.0038	-0.0029	-0.0029
community cluster	--	--	--	--	0.70
r ²	0.069	0.081	0.105	0.152	0.152
F	7.82	6.19	6.13	7.45	6.19
sig.	0.001**	0.000***	0.000***	0.000***	0.000***

When we add settlement land to the regression, model 3b explains 19.9% of the variance. The effect of land, in this case, is negative. For each hectare of settlement land

accessed by households, the model predicts a decrease of R\$8.29 in total output of babassu. For the settlement areas under examination, this would cause annual reductions in the range of R\$91 (São José) to R\$224 (São Francisco). The incorporation of capital assets in model 3c adds only 0.6% to the variance explained. According to the model, the influence of capital assets in babassu output is also negative. In this case, the variable used was the index for ownership of durable utensils. For each unit of increase in the index, corresponding to R\$4.80, the model predicts that babassu output decreases by R\$0.16. This effect is illustrated with the example of a household in São Manoel that increases utensil assets on the order of one standard deviation (239), from the average index value of 236. The model predicts that household annual output from babassu decreases by R\$38. By adding private land to the regression, (as is the case when households in a settlement project purchase an additional property), model 3d explains another 0.5% in the variance of babassu output. Finally, model 3e includes the “community effect” and explains 22.1% of the variance. Once land, labor, and capital are introduced as controls, the annual output of babassu for Pau Santo households is \$116.32 smaller compared to São Manoel households.

The lower part of Table 6-11 shows the effect exerted by labor on the proportion of babassu in total output (model 4a). Additional female adult-equivalent units increase the proportion of babassu in total output between 9.8 and 10.7%, while additional male adult-equivalent units decrease the proportion by 6.0 to 6.7%. The incorporation of land and capital increases the amount of variance explained from 6.9 to a total of 15.2%. Model 4b shows the negative effect of settlement lands. Each additional hectare lowers the proportion of babassu by 0.47%. As model 4c indicates, the availability of capital

influences the proportion of babassu output in the same direction: each R\$100.00 earned by the household during the year (as wages, stipends, or salaries) predicts a decrease in babassu on the order of 0.03%. Model 4d shows that access to land, regardless of private or settlement land, decreases the participation of babassu in total allocation output. Finally, model 4e incorporates the “community effect,” showing that, once controlling for factors of production, there is no increase in the amount of variance explained. In addition, model 4e indicates that the proportion of babassu in allocation outcomes is little affected (by only 0.7%) by the “community effect.”

Effect of land, labor, and capital on cattle output, and on proportion of cattle in total output

The third series of models clearly indicates that land is the most relevant factor of production for cattle ranching. Model 5a, which includes only the effect of private land, explains 77% of the variance in cattle output. The model predicts that each additional hectare of private land provokes an increase in cattle output in the order of R\$32.42. As seen in models 5b to 5e, the incorporation of all other variables increases the percentage of variance explained by only 1.2 points. These models indicate that accessibility to settlement land also predicts increase in cattle output, although at a much smaller degree. The models predict small positive effects of capital and male labor, while female labor is seen as the only variable negatively affecting cattle output. Model 5e shows that “community effect” explains no additional variance in cattle output, and indicates that once controlling for land, labor, and capital, the fact of living in Pau Santo increases the annual output generated from cattle ranching by R\$5.31.

Table 6-12. Regression of cattle output, and proportion of cattle on total output, on land, labor and capital

Cattle output	Model 5a	Model 5b	Model 5c	Model 5d	Model 5e
(constant)	49.87	-11.28	11.70	-7.31	-9.35
independent variables					
male labor	--	--	--	2.37	2.54
female labor	--	--	--	-26.82	-26.74
total labor	--	--	-8.69	--	--
private land	32.42	31.13	31.08	31.60	31.63
settlement land	--	--	--	4.13	3.99
capital: utensil assets	--	0.301	0.112	0.267	0.267
community cluster	--	--	--	--	5.31
r ²	0.766	0.773	0.773	0.778	0.778
F	732.32	378.17	251.44	153.06	126.98
sig.	0.000***	0.000***	0.000***	0.000***	0.000***
Cattle proportion	Model 6a	Model 6b	Model 6c	Model 6d	Model 6e
(constant)	7.74	6.11	6.90	5.67	7.63
independent variables					
male labor	--	--	--	0.55	0.39
female labor	--	--	--	-1.64	-1.74
total labor	--	--	-0.28	--	--
private land	0.66	0.63	0.63	0.65	0.63
settlement land	--	--	--	0.23	0.36
capital: cash income	--	0.0022	0.0027	0.0020	0.0021
community cluster	--	--	--	--	-5.20
r ²	0.340	0.360	0.360	0.375	0.384
F	109.35	59.29	39.39	24.98	21.52
sig.	0.000***	0.000***	0.000***	0.000***	0.000***

Similar trends are predicted when the dependent variable is the proportion of income derived from cattle (models 6a to 6e). Model 6a shows that private land explains 34% of the variance in this variable. Each additional hectare of private land increases the proportion by 0.66%. When we add controls for labor and capital (models 6b to 6d), there is a small increase in the percentage of variance explained by the models: up only to 37.5%. Model 6b predicts a small positive effect associated with capital (0.27% increase for each R\$100 earned by the household during the year). Model 6c shows that increases in total availability of labor negatively affect the proportion of income from cattle. When male and female labor are treated separately (model 6d), we observe opposite effects on cattle income (+ male; - female). Model 6d also predicts that access to settlement land

increases the relative proportion of cattle in total outputs. Finally, model 6e includes a dummy variable for place of residence. Contrary to expectations, the proportion of the output contributed by ranching was 5.20% higher in São Manoel than in Pau Santo.

These exercises are useful in predicting the influence of factors of production in household resource-allocation decisions, and that ultimately lead to a given level of output. With the exception of the output from cattle ranching, the amount of variance explained by these models is relatively small. To increase the explanatory power of the models, a broader set of variables is added to the regression equations presented next.

Multivariate Econometric Models for Resource-Use Trajectories

In addition to the effect of land, labor, and capital endowments, the key economic activities were regressed on a broader set of variables. I selected those independent variables that showed at least a moderate bivariate correlation with the main output measures. The selected variables were:

- Cultural features: origin of the household head (local, from other parts of Maranhão, or from other states, particularly Ceará and Piauí).
- Institutional background: whether the household was affiliated with a local association of producers, or with the agro-extractive cooperative.
- Education: years of formal education of the household head.
- Household size and composition: number of people in the household and their conversion to adult-equivalent units of consumption, and the “demographic differentiation,” or the stage of household in life cycle, as reflected by the age of household head, and the ratio of adult-equivalent consumers to adult equivalent producers.

Table 6-13 summarizes correlation coefficients for interval-level variables, while the comparison of means for categorical variables is presented in Table 6-14. The comparison of means and the analysis of correlation coefficients indicate that origin and education of both males and females, and the stage of the household’s life cycle, appear to have little effect on total and relative output of crops, babassu, and cattle. The variation

within each of the categories for these variables is likely to be greater than variations between categories. Yet, when life cycle is directly assessed through age of males and females, a statistically significant increase is observed with respect to total and relative output from ranching.

Table 6-13. Correlation coefficients between selected variables and allocation strategies

Variable		Total output			Proportion of output		
		Agriculture	Babassu	Cattle	Agriculture	Babassu	Cattle
Age male	cc	0.120	0.086	0.171	0.003	-0.134	0.212
	sig.	0.095	0.229	0.017*	0.973	0.070*	0.004**
Age female	cc	0.050	-0.042	0.233	-0.070	-0.128	0.293
	sig.	0.477	0.548	0.001**	0.322	0.072	0.000***
People in household	cc	0.188	0.395	-0.031	-0.063	0.121	-0.093
	sig.	0.004**	0.000**	0.641	0.356	0.078	0.175
Consumer equivalent	cc	0.246	0.404	-0.038	-0.024	0.064	-0.064
	sig.	0.000***	0.000***	0.573	0.732	0.352	0.352
Cons/prod ratio	cc	-0.091	-0.065	0.144	-0.129	0.053	0.111
	sig.	0.175	0.332	0.030*	0.059*	0.437	0.106
Education male	cc	-0.090	-0.026	-0.015	-0.072	0.109	-0.062
	sig.	0.208	0.713	0.839	0.327	0.141	0.399
Education female	cc	-0.099	-0.048	-0.023	-0.065	0.099	-0.059
	sig.	0.157	0.491	0.740	0.361	0.162	0.410

*** p<0.001, ** p<0.01, * p<0.05

Institutional memberships (associations of producers and cooperative) have a more substantial effect on income from ranching. Similarly, size and composition of household (when measured in terms of adult-equivalent units of consumption, and by the ratio between consumer and producer adult-equivalents) show sizeable effects.

Variables somewhat correlated with absolute and relative output for crops, babassu, and cattle were then incorporated into the models that better predicted resource output and allocation proportions when regressing only land, labor, and capital assets (models "e" in Tables 6-10 to 6-12). All the variables were initially tested. The ones that did not improve the explanatory power of the regression models were eliminated.

Table 6-14. Analysis of variance for selected variables and allocation strategies

		Total output (R\$ equivalent)			Proportion of total output (%)		
		Crops	Babassu	Ranching	Crops	Babassu	Ranching
Origin male							
ANOVA significance		0.012*	0.649	0.912	0.358	0.367	0.517
same municipality	mean	409.14	514.59	198.92	35.45	54.80	9.76
	n	93	93	93	89	89	89
	st.dev	(448.80)	(411.25)	(699.95)	(31.57)	(33.24)	(21.91)
other municipality in Maranhão	mean	700.82	580.33	245.05	44.03	46.45	9.52
	n	48	48	48	44	44	44
	st.dev	(669.28)	(542.93)	(583.75)	(32.24)	(33.01)	(17.27)
other state (Ceará, Piauí)	mean	607.40	575.11	225.23	37.03	49.35	13.63
	n	55	55	55	52	52	52
	st.dev	(699.93)	(506.41)	(517.86)	(35.37)	(35.81)	(22.29)
Origin female							
ANOVA significance		0.644	0.425	0.122	0.546	0.771	0.100
same municipality	mean	510.56	610.72	142.01	35.96	56.17	7.87
	n	97	97	97	95	95	95
	st.dev	(556.64)	(489.63)	(404.55)	(31.27)	(32.48)	(17.58)
other municipality in Maranhão	mean	465.41	547.04	386.55	30.36	54.46	15.19
	n	66	66	66	63	63	63
	st.dev	(559.62)	(386.85)	(1,137.22)	(30.32)	(34.35)	(28.39)
other state (Ceará, Piauí)	mean	573.38	507.42	237.78	34.70	51.65	13.66
	n	44	44	44	42	42	42
	st.dev	(698.79)	(502.41)	(552.99)	(34.67)	(36.83)	(21.27)
Membership in association							
ANOVA significance		0.001**	0.179	0.242	0.044*	0.028*	0.676
not a member	mean	388.12	570.30	280.51	31.81	57.20	11.00
	n	127	127	127	118	118	118
	st.dev	(472.94)	(488.39)	(920.04)	(30.41)	(32.87)	(23.19)
member	mean	644.32	487.07	167.30	40.93	46.78	12.29
	n	99	99	99	96	96	96
	st.dev	(666.06)	(421.38)	(311.78)	(35.28)	(35.95)	(21.67)
Membership in cooperative							
ANOVA significance		0.050*	0.382	0.666	0.091	0.018*	0.249
not a member	mean	471.97	543.95	223.11	34.45	54.64	10.90
	n	198	198	198	187	187	187
	st.dev	(574.09)	(461.58)	(752.63)	(33.36)	(35.08)	(22.68)
member	mean	701.04	462.31	286.16	45.91	37.85	16.25
	n	28	28	28	27	27	27
	st.dev	(580.42)	(459.62)	(439.10)	(28.26)	(27.27)	(20.87)
Household stage in life cycle							
ANOVA significance		0.274	0.073	0.115	0.377	0.134	0.039*
younger	mean	382.34	351.37	35.00	42.66	54.11	3.23
	n	25	25	25	23	23	23
	st.dev	(380.11)	(229.79)	(88.09)	(29.71)	(28.62)	(7.09)
intermediate	mean	475.75	580.28	194.06	33.35	56.21	10.43
	n	122	122	122	119	119	119
	st.dev	(531.35)	(420.40)	(619.53)	(31.37)	(33.39)	(21.15)
older	mean	575.67	519.85	349.84	37.94	45.92	16.13
	n	79	79	79	72	72	72
	st.dev	(686.97)	(555.58)	(933.87)	(36.23)	(37.64)	(26.68)

*** p<0.001, ** p<0.01, * p<0.05

Models presented in Table 6-15 explain the highest possible amount of variance in total and proportional output for the three activities. In certain cases, higher variance was explained after deleting one or more of the land, labor, or capital-related variables. For each case, models are presented as pairs ("a" and "b"). The ones on the right side (models "b") incorporate the "community effect." These models confirm that land, labor, and capital explain the greatest share of the variation in the outcomes. Comparisons of r-square values in Table 6-15 with values of models "e" in Tables 6-10 to 6-12 further indicate that the additional amount of variance explained by incorporating other variables is smaller than 3% in most of the models. Substantial increases were verified only for models predicting the proportion of output from cattle and babassu. Additional variance in the proportion of cattle income increased by 10%. The one for babassu increased by 6.5%. The smaller increase was found in models predicting babassu output, which increased by only 1.8%.

In terms of individual variables, membership in the cooperative is statistically significant in all six sets of models. When the community effect is not included, the models predict that cooperative membership increases absolute and relative output of crops (by respectively R\$151 and 7%), and cattle (by respectively R\$211 and near 10%). Surprisingly, cooperative membership is negatively associated with babassu absolute output and proportional outputs (by R\$122 and 22%). The findings suggest an improved socioeconomic status among cooperative members, who tend to have a more diversified economic strategy. Association membership, on the other hand, was not a variable included in models predicting the proportion of income from babassu allocation.

Table 6-15. Regression models for total and relative output for crops, babassu, and cattle

Crop output	Model 7a	Model 7b	Crop proportion	Model 8a	Model 8b
(constant)	174.50	105.90	(constant)	48.20	44.12
indep. Variables			indep. Variables		
male labor	140.46	142.74	male labor	10.01	9.71
capital: cash income	0.050	0.051	female labor	-4.59	-4.63
age of female head	2.67	2.81	private land	-0.317	-0.283
education female	-3.39	-3.52	settlement land	-0.022	-0.242
female from Ceará	-171.88	-171.07	capital: cash inc.	0.00065	0.00064
cooperative member	150.78	119.04	coop. Member	7.02	9.24
association member	221.10	175.10	associat. Member	7.28	8.63
consumer/labor	-57.70	-42.79	size of household	0.987	0.717
community cluster	--	112.77	adult equiv.-cons.	-5.74	-5.02
r ²	0.154	0.161	consumer/labor	-8.47	-7.67
F	4.49	4.19	community cluster	--	6.70
sig.	0.000***	0.000***	r ²	0.112	0.118
			F	2.54	2.44
			sig.	0.007**	0.007**
Babassu output	Model 9a	Model 9b	Babassu Proportion	Model 10a	Model 10b
(constant)	362.19	444.43	(constant)	56.09	57.23
indep. variables			indep. variables		
female labor	42.09	29.69	male labor	-12.59	-12.49
private land	4.18	3.39	settlement land	-0.486	-0.430
settlement land	-10.65	-6.08	private land	-0.430	-0.439
capital: utensil asset	-0.237	-0.247	capital: utensils	-0.0051	-0.0050
age of male head	2.75	2.90	age of female head	0.154	0.150
cooperative member	-122.51	-185.59	female from Ceará	8.86	8.75
male from Ceará	27.55	32.42	education female	0.188	0.192
size of household	72.13	73.09	coop. member	-21.70	-22.49
consumer/labor	-170.23	-189.04	---		
community cluster	--	-153.87	community cluster	--	-2.61
r ²	0.228	0.239	r ²	0.216	0.216
F	7.36	7.11	F	5.81	5.22
sig.	0.000***	0.000***	sig.	0.000***	0.000***
Cattle output	Model 11a	Model 11b	Cattle proportion	Model 12a	Model 12b
(constant)	-35.08	-34.04	(constant)	-17.38	-15.64
indep. variables			indep. variables		
male labor	-29.57	-29.48	male labor	4.84	4.80
private land	31.93	31.92	female labor	3.82	3.54
settlement land	20.90	20.98	private land	0.797	0.781
capital: utensils	0.336	0.336	settlement land	0.586	0.682
age female head	0.011	0.011	size of household	-2.54	-2.53
adult equiv.-cons.	15.18	15.06	age male head	-0.291	-0.274
cooperative member	211.20	210.46	age female head	0.255	0.241
association member	-435.58	-435.94	education male	-0.132	-0.144
community cluster	--	-2.03	education female	0.067	0.080
r ²	0.807	0.807	consumer/labor	20.03	19.63
F	102.86	90.65	coop. member	9.81	8.88
sig.	0.000***	0.000***	associat. member	-10.05	-10.55
			male from Ceará	4.87	4.95
			community cluster	--	-2.93
			r ²	0.480	0.483
			F	11.14	10.40
			sig.	0.000***	0.000***

Compared to cooperative membership, association membership predicts even higher absolute output and relative output of crops (by R\$221 and 7.3%). However, the variable influences cattle ranching in the opposite direction: models 11a and 11b predict that members of associations obtain R\$434 less from cattle ranching than non-members. As a result, the relative contribution of the activity is 10% lower.

The “community effect” is more pronounced for crops. Once all other variables are entered, model 7a predicts that output of crops is R\$112.77 higher for households in Pau Santo than in São Manoel. In addition, the relative contribution of crops in the former is 6.7% greater compared to the latter. These differences compare with R\$62.49 and 4.6% observed when regressing crops on land, labor, and capital only. The incorporation of other variables also gave the same direction to the “community effect” for total and relative outputs for babassu and cattle. Contrary to opposite effects of models 3e and 4e (and between models 5e and 6e), models 9b and 10b predict that households in São Manoel obtain R\$153.87 more from babassu than those in Pau Santo. Babassu also contributes 2.61% more to the proportion of output. Models 11b and 12b predict similar community effects for the absolute and relative contribution of cattle, respectively R\$2.03, and 2.93% higher in São Manoel.

Overall, these models indicate, on the one hand, that cattle ranching is fairly predictable given a relatively restricted set of variables. This is verified by relatively high r-squares in models 11 and 12. On the other hand, the low r-squares for babassu (models 9 and 10), and mainly for crops (models 7 and 8) perform poorly in predicting the

outcomes of investment in these activities.¹¹ These findings are inserted next, in the final remarks on allocation strategies, that conclude this chapter.

Discussion and Conclusion

The quantitative analysis on Pau Santo and São Manoel fulfills the main purpose of providing empirical evidence to complement ethnographic observations regarding the diversity of economic strategies in the communities. Such diversity reflects the cumulative effect of dynamic transformations that gradually change the socioeconomic and biophysical configurations of each community.

Hence, in Chapters 3 and 4 I presented ethnographic evidence that distinct internal constructs guided the socio-natural trajectories of Pau Santo and São Manoel. The quantitative examination in this chapter confirms that these two apparently similar peasant economies function according to markedly different underlying values, principles, and production strategies. If, on the one hand, these differences seem to have been the product of dissimilar natural endowments, in reality they reflect a more profound contrast in the way social relations, community life, and the appropriation of common goods and services were developed in each case.

In the first part of the analysis, the statistical examination of income composition confirms that cropping on roças remained the major objective of households in Pau Santo, whereas the integration of cattle ranching and babassu extraction with annual crops was greater in São Manoel. I contend that such an outcome reflects the concerted effort by São Manoel peasants to put aside their disagreements and discords to develop an

¹¹ The low variance explained could be due to the fact that in some places nearly everybody engages in the activity; hence, there is no variance to explain. Alternatively, it could be because no one does it (or very few), and hence, it is also a constant. Finally, low variance explained could be because some do/some don't (hence there is variance), but the model is misspecified--that is, it does not contain a correct independent

economic strategy that improved the benefits provided by the market and community institutions. Additional indicators, such as higher levels of wealth and well-being in the community indicated improved standards of living.

Sticking to annual crops turned out to be the only possible trajectory in Pau Santo, not because local residents intended to do so, but because of the barriers imposed by discord and turmoil that characterized the community internal social relations (discussed in more detail in Chapter 7). Indeed, the trajectory of land occupation in Pau Santo, associated with a sequence of unfortunate events that bolstered internal contradictions, undermined the capacity of local people to devise the optimal way to interact with their proximate environment. For the most part, these factors worked against the principles of community cooperation.

The examination of gini coefficients, however, shows that income and assets are more highly concentrated in São Manoel. The results pose a challenging puzzle to be unraveled by those who proclaim the advantages of highly integrated communities. Evidently, expanded economic opportunities in São Manoel appear to have benefited only part of the community at this point. Yet, careful examination of the data indicates that the lower tails in the distribution of income and assets for São Manoel are significantly higher than the lower tails in Pau Santo. Table 6-16 shows that, except for non-monetary income, households positioned in the lower 10% fared better in terms of all the variables in São Manoel, compared to Pau Santo. Therefore, the attainment of higher minimum standards in São Manoel thus reduces the negative consequences of concentration. When these findings are joined with ethnographic observations, the results

variable; hence, variance explained is low. Whether scenarios A, B, or C apply in this case may very well vary for each of the different variables in question.

suggest that, rather than exclusively considering the degree of concentration of income and goods, more reliable assessments of a community's internal social relations should also take into account minimum needs for subsistence. The failure to achieve these standards in Pau Santo may well be one of the factors that promotes internal strife, and that markedly influences economic strategies and resource-allocation.

Table 6-16. Distribution of income and asset measurements according to percentiles

	Cluster	Percentile						
		5	10	25	50	75	90	95
PAI	Pau Santo	.98	1.56	4.35	17.69	48.64	162.36	323.78
	São Manoel	.42	.88	3.32	7.85	26.82	78.07	96.85
DUI	Pau Santo	.00	10.42	41.67	135.42	395.83	540.62	723.96
	São Manoel	.00	.00	41.67	166.67	385.42	562.50	595.83
HCI	Pau Santo	281.72	332.00	403.38	520.54	681.50	760.15	831.62
	São Manoel	227.64	263.40	324.02	437.00	497.50	632.70	646.65
Total Income	Pau Santo	665.48	1165.47	1613.59	2626.70	4403.88	6588.20	9090.34
	São Manoel	617.38	959.70	1687.45	2600.25	4115.75	5622.48	6713.65
Monetary income	Pau Santo	255.70	448.05	844.75	1688.50	3301.38	5801.00	8149.45
	São Manoel	153.50	240.38	684.75	1508.75	3027.50	4391.00	5414.70
Non-monetary income	Pau Santo	162.05	249.02	510.25	816.25	1186.13	1530.55	1993.40
	São Manoel	177.30	283.40	574.80	898.00	1421.03	1844.99	2043.37

The second part of the analysis tested the applicability of statistical models in predicting trajectories of land and resource-use in peasant communities of the Mearim Valley. In addition to assessing the validity of the predictions, the exercise identified a wide range of survival strategies based on the relative importance of crops, babassu extraction, and cattle ranching. Indicators of the proportion of output from each activity suggest that households in both communities attribute distinct priority to cropping, extraction, and ranching. These activities are combined in different ways to comprise the livelihood profiles in each community. The analysis of the portfolio of household

allocation decisions supports the hypothesis that the observed transformations in the socio-natural ensembles are due less to a particular economic investment than the general principles that orient the ways in which households interact with one another.

One of the main points extracted from this analysis is that, despite the power of statistical inferences, one has to be cautious about attributing general features to peasant social and economic systems using these methods alone. The complexity of internal relations within communities, and their expression in multiple domains of daily life, are based on historical trajectories that are not easily captured by statistical models. The latter offer useful insights, but only in the context of a deeper and longer-range understanding that is provided by the ethnographic method.

CHAPTER 7

SOCIAL ROOTS OF DIFFERENTIAL RESOURCE-USE

In Chapter 4, I examined the differences between land-use trajectories in Pau Santo and São Manoel. The analysis emphasized the different forms through which portions of their land were reconverted into secondary growth, and later used for cultivation. In Chapters 5 and 6, I employed remote sensing and statistical analyses to empirically document the differences between the two communities. These analyses reaffirmed the notion that despite similarities, Pau Santo and São Manoel constitute distinct socio-natural ensembles and therefore respond in different ways to the complex and dynamic processes that influence land-use/cover outcomes. This diversity can be explained, on the one hand, by differences in tangible socioeconomic determinants and concrete material conditions in each community. On the other hand, the interplay of socioeconomic and biophysical factors, and the influence of structural, relational, and symbolic determinants, may activate distinct underlying structures of signification in each community. Such principles would then promote or constraint different resource-allocation decisions, producing distinctive practices and outcomes.

In previous discussions I have argued for the use of multiple reinforcing domains of explanation to assess land-use/cover outcomes derived from changes in the landscape, and in more general terms, from interactions between humans and the environment. In this chapter, I contend that once these multiple domains are recognized, and their interaction is analyzed, the researcher has to pursue deeper understandings of the complex relationships among them. The need to verify the existence of social roots of

transformations in socio-natural ensembles is guided by the assertion that, although it is critical to recognize events and processes that through distinct domains promote social and natural changes, greater theoretical and applied achievements require further scrutiny of the order of causality among these factors and domains. There will not always be an overarching and dominating force for every single context, or ensemble. There are cases in which multiple forces operate in balanced unison for the resulting output. However, in certain situations, the seemingly balanced influence of multiple factors and domains is the consequence of processes strongly activated by one or more of the forces. According to this approach, only partial assessments are produced when the identification and correct interpretation of the order of causality are not addressed. If an order of causality can be identified, this means that particular factors are at work in triggering complex processes that involve the subsequent manifestation of multiple domains and scales, such as those noted in Chapters 1 and 2. Once the differential outcomes are exposed, and the range of possible intervening variables and domains of explanation are presented, the next step is to comparatively examine critical and distinct aspects of the socioeconomic and biophysical configurations in each community. By progressively contextualizing (Vayda 1983) the events at place, we are then able to interpret whether or not there is an ultimate cause of differential outcomes.

There are cases in which conditions of the natural environment are considered the most important factor that accounts for differences in resource-use decisions. Certain soils, for example, cannot support intensive agriculture without added fertilizers; others are particularly favorable to sequential cultivation. The scarcity or inaccessibility of land constrains certain economic activities. In other cases individual agents are the primary

trigger of such different responses. Still other responses are led by the insertion of such agents into broader social structures. In the cases studied here, we are tempted to associate the greater availability of land and resources in Pau Santo to the lower importance given to environmental conservation in that community, as well as with their insufficient social mobilization, and lower efficiency in overall land-use planning. The reverse order would apply to São Manoel's comparatively scarce resources. A contrasting line of reasoning attributes the optimization of the use of scarce resources in São Manoel to the community's high degree of internal cohesion, and its ability to "remember," or transfer principles of social organization learned during the time of the land conflict, to the post-struggle period. Pau Santo's internal discord and inability to provide institutional governance, on the other hand, hindered optimal resource-management strategies.

One can debate which of the above assertions better fits the explanation of socio-natural changes in Pau Santo and São Manoel. However, a careful examination of the historical background of the communities points to the conclusion that neither of the above can be considered the ultimate factor accounting for differential resource-use, the combination of these aspects being critical to today's outcomes. Hence, it is my objective to show that the social roots that triggered not only the differences in land-use trajectories, but also the contrasting ways in which social relations and community life are manifested in Pau Santo and São Manoel, are the different forms through which residents in both communities have experienced socio-natural ensembles, and differences in the way they acted during crucial moments in the formation of their respective perceptions. Such proposition emphasizes the need to incorporate an historical perspective. By examining continuities and breakdowns in social relations and social

positioning over extended periods, we can better comprehend the operation of today's socioeconomic configurations, and their interplay with the biophysical environment.

The qualitative and quantitative conditions of natural resources play a fundamental role. However, scarcity or abundance of land, and particularly in this case, of land suitable for shifting-cultivation, should not be viewed as the only underlying factor that explains the existence of heterogeneous socio-natural ensembles. On the other hand, even though a greater weight should be given to the social trajectories that led up to the conditions that today prevail in São Manoel and Pau Santo, it is also inappropriate to state that cooperation and agreement in the former, and discord and individual orientation in the latter, are innate characteristics of people who live in these communities today. I contend that these features are themselves the product of social facts that marked the two communities in the past, fashioned during the initial period of land occupation and the subsequent phase of state-supported land privatization. These processes and relationships nonetheless reflect the predominant contrasts between, on the one hand, Pau Santo's background of hierarchical and subordinated social relations, and on the other hand, São Manoel's more egalitarian peasantry. In other words, today's discrepancies in land-use trajectories and social life can be traced back to the attitudes, and the agency of residents in the communities as they confronted socio-structural and ecological opportunities and constraints in the past. To illustrate this point, I begin by contrasting the violent episodes in Pau Santo and the absence of violence in São Manoel. Whereas previous chapters argued that the lack of proper land-use planning in Pau Santo reflected the absence of internal cohesion within the community, the following discussion shows how responses to violence reinforced the lack of internal cohesion that was already evident.

Discord and Violence

Perhaps one of the most telling indicators of the social conditions prevailing in human settlements is the expression of violence. Violent events are often associated with the occupation of lands in the frontier. Violent episodes tend to diminish over time with the gradual emergence of notions of citizenship that accompany the integration of such lands into spheres of institutionalized social organization. As noted in Chapter 3, violence was omnipresent in Lago do Junco during the 1970s and 1980s, when diverse conflicts marked the municipality. Agrarian conflicts were the more visible expression of violence. Land conflicts in Lago do Junco resulted in the murder of eight people. During their peak, from the mid-1980s to the early 1990s, these struggles comprised, on the one hand, the elimination of villages and the instigation of fear by armed gunmen who patrolled private properties. On the other hand, the strategies of resistance adopted by peasants included the killing of livestock, and the dismantling of fences and ranching facilities.

Although agrarian conflicts are an extreme manifestation of social inequalities, they do not constitute the genre of violence that will primarily inform this analysis. To a certain degree, people who engaged in agrarian conflicts in Lago do Junco were applying practices and attitudes that already defined their prevailing social milieu. Individuals who participated in land struggles diverted to new ends the older forms of violence present in their ordinary social interactions. When the material conditions of existence and the reproduction of an entire social group are at stake, previously existing traits were not only replicated and strengthened, but also infused with new ideological and symbolic dimensions. The fact that social interactions in Lago do Junco were marked by manifestations of violence prior to land conflicts is exemplified by the intense disputes among families, notably the confrontation between the Barbosas from Lago dos

Rodrigues and the Ledas from Lago do Junco (Chapter 3). The series of violent incidents that were observed during the 1960s, 1970s, and 1980s in the daily routines of Lago do Junco were far out of proportion for such a small town. The point here is the notion that ordinary violence impregnates and permeates much of the daily routines visible in local towns. Similarly, peasant communities are the stage upon which violent episodes are played out in different forms and degrees of intensity. Thus, the study of violence is not only essential to an understanding of daily rural life, but is also an entry point for understanding changes in social relations, and the effect that such changes carry for land- and resource-use.

In contrast to the impersonality of most violent episodes in western, “modern” societies, violence within peasant communities assumes rather personal dimensions. Violent episodes are frequently associated, for example, with the breach of honor due to extramarital (or pre-marital) relations, or involve disputes for social prestige or dominance. Violent transgressions often take place in social gatherings such as parties or clubs, often under the influence of alcohol. Drugs, notably marijuana (*maconha*) are said to be implicated in recent cases involving youths, both in the city and rural communities. Violent events are also related to economic stress, and to political disputes. When a visitor spends enough time in the town or in peasant communities of Lago do Junco, he or she is likely to witness mild violent episodes, even within households. But once one establishes a rapport with residents of various communities, is possible to identify varying degrees of violence within human relations. Pau Santo and São Manoel, for example, are clearly distinct in this regard.

The expression of violence in São Manoel is generally restricted to minor household episodes that rarely come to attention outside the community. In Pau Santo, in contrast, violence has been one of the major features of community's social relations. Pau Santo's residents still carry and frequently use revolvers and knives that are hidden under clothes and taken to town and local social gatherings. It is not surprising that a number of extremely violent incidents have occurred, bestowing on Pau Santo the notorious reputation as a violent and dangerous place. Incidents that came to my personal attention in 2001 and 2002 suggested a connection between violence and the lack of institutional forms of governance, including the lack of land-use planning. Whereas not a single such case was reported in São Manoel, at least six extreme cases of violence occurred in the post-conflict period in Pau Santo. Although I will not go into details about the cases, and will not reveal the names of those involved, an analysis of these episodes substantiates the argument that violent relations are a critical aspect of social life in Pau Santo.

Violent Episodes in Pau Santo

The first case happened in May, 2002 when Maria was only 16 years old, the oldest of 8 children of João Luis, who was abandoned by his wife a few years earlier. Their house was built during the settlement project, but still lacks a door and windows. The house is located less than 100 yards from the school that was recently remodeled and enlarged. Classes in the morning and afternoon are held for younger children, while older students (middle school) attend in the evenings. Since the year 2000, these evening classes are taught with the use of videotapes and television-sets, and are called Tele-Sala. A single instructor is in charge of the entire course, to the mixed reaction of locals. The Tele-Sala instructor in Pau Santo's school is from the community, a young man who has recently graduated from high school in Bacabal. Classes run from 7 to 10, when a truck

paid for by the City takes neighboring students home. After classes are over, local residents are authorized to watch television in the school. On one of these nights, Maria, who is not a student, was in the building and was violently raped by two young men. One was the teacher himself. The other teenager, who lives across the street, also had secondary education. They tied Maria and covered her face with their clothes, so she could not yell. Maria's father was passing by the school when the rape was taking place. He heard noises, but thought it was people watching television. Later he saw one of the men jumping over the wall. When he returned home, he noticed that Maria was not in her hammock. By that time, the other man had also left. When I learned about the case, a month had passed, and the perpetrators were hiding in Bacabal. The fathers of both young men were active during the land conflict period, and to this day are consulted regarding issues related to community organization. There were rumors in the community that João Luis would take justice into his own hands.

A few weeks before Maria's rape, an even more drastic episode shook the community. Amâncio and Juvenal were friends and drinking partners. They both lived in Vila São João, one of the settlement areas connected to Pau Santo. Amâncio was the son of a senior resident in Pau Santo, while Juvenal, although recently arrived, was married to the daughter of a local family. One Sunday afternoon, Amâncio killed Juvenal. He first used a shotgun but only injured his former friend, who then tried to run away, but fell. Once Juvenal was down, Amâncio cut Juvenal's throat with such force that Juvenal's head was nearly severed from his neck. Amâncio left the village, accompanied by his entire extended family. People still avoid further comments, but some have said that drugs were implicated in the murder.

The above episodes, which occurred in 2002, confirmed a trend that I began to observe in the previous year. When interviewing people in the fall of 2001, I learned that a 15 year-old boy had killed his younger friend. They were both fishing in one of Pau Santo's water streams, but the younger one was more successful with the catch. When the younger boy demanded a part of the catch but was refused, he simply took the shotgun he was carrying and shot his young companion to death. Again, the killer's family abandoned Pau Santo. The parents of the deceased, disgusted with the episode, also left.

In the same period I was told about ongoing quarrels between Juca Lemos and two brothers of the Martins' family, one of the largest and more powerful in the village. Juca is an outsider, who recently had married Joana, daughter of Romão and Cida, respectively one of the religious leaders and the former president of the women's club in Pau Santo. Juca is an alcoholic, and often threatens his wife and in-laws when he is inebriated. He claims to have learned some sort of martial arts while living in Bacabal, and was inclined to publicly express his disdain toward others. When the Martins did not accept Juca's defiant attitude, it resulted in several arguments and fights. The Martins' brothers attempted to kill Juca in an ambush just outside the village, when Juca was on his way to the city. He escaped being killed only because someone warned him to not cross the path alone. He got a ride on a motorcycle, and the ambushers were unable to hit their target. But Juca's future in Pau Santo is likely to be short-lived, as many in the community believe that he should either leave or die.

These recent events are nothing new in Pau Santo. At least since I started working in the community, 15 years ago, similar cases were observed. In Chapter 3, I recounted the quarrel that, in the early 1990s, pitted the Pereira and the Paiva families against one

another, and destabilized social relations and the balance of leadership in the community. The quarrel culminated in the clash that left Riba Pereira deeply wounded by Chico Paiva's knife. The attack was to demonstrate that the Pereiras would not tolerate the courtship between a married man and Francisco's younger sister.

In the late 1980s, a few years after the resolution of the land conflict, a drunken man called Antonio defied a group gathered in Pau Santo's church. Antonio, who was not considered a trustworthy person by those involved in the land confrontation, entered the church yelling cusswords, armed with a peixeira, a large knife. He began to hit the knife against the seats and walls, wounding two in the church, and provoking the rage of the congregation. The men in the church overpowered Antonio, dragged him outside and proceeded to kill him by smashing rocks over his skull.

Acts of such physical brutality have not been the only expression of violence in Pau Santo. A case that is particularly representative of the state of affairs in the community occurred in 2002 against dona Nilza, an elderly woman who claimed retirement benefits for more than five years. People whose retirement checks are not released have the right to file for retroactive reimbursement, and dona Nilza was instructed to do so. It took several years, but late in 2001 she finally learned that her money was to be paid. She was entitled to R\$12,000 (the equivalent of almost US\$5,000). She had to pay a substantial share of the money (about 25%) to a broker from the community, who supposedly sped up the social security bureaucracy, and arranged for her to travel to the city to receive the payment. Knowing that she was deceived by this broker, dona Nilza was nonetheless very happy when I spoke with her in October 2001. She was building two more rooms, a kitchen, and a porch on her house, and had recently

purchased a cow. Still, she reported that, as soon as she got the money, people from all over the community approached her for loans. When I returned to Pau Santo almost one year later, in June 2002, I was surprised to find dona Nilza completely distressed. She had fallen ill, a skin irritation that, as she said, was burning her entire body to a point that she could not wear clothes. Later, dona Nilza told me that the morning after she finished the construction of her house, she found a strange piece of clay in her porch, just like the clay from Pau Santo's cemetery. She regrets she did not realize she should not touch the clay, as it was placed there as part of a witchcraft ritual. Soon after that, dona Nilza began to feel the symptoms of her illness, and never recovered. In her view, the illness was provoked by someone from the community who could not tolerate her wealth. My interpretation, however, was that dona Nilza herself never came to terms with the fact of earning a large sum of money. In a place where the norm is to seek advantage from those in better economic circumstances, dona Nilza suddenly came herself to be the object of envy, a role that she had never before experienced.

The succession of such incidents, impregnated with physical violence and other acts that would be considered deviant social behavior, denote the pattern of human relations in Pau Santo. Yet, during most of the time, Pau Santo is a community that resembles many others, like São Manoel. Such incidents are not constantly present in the ordinary life of the community. Violent episodes occur in pulses that periodically disturb the social fabric. It is their recurrence that creates, in my interpretation, a social environment of distrust that undermines, and renders unfeasible, the execution of collaborative efforts.

Still, the question remains: why are human relations impregnated with this characteristic in Pau Santo, but not in São Manoel? What are the underlying features that prompted violent episodes and the consequent instability in social relations in one place, while it was possible for people in the other to build a safety network to overcome internal differences and promote community welfare? I began to better understand the reasons for such differences when studying the detailed composition of the communities. In the next section, I present the data that substantiate the assertion that much of the differences between Pau Santo and São Manoel's socioeconomic configurations is due to the structure and composition of the communities, particularly in terms of the existence of kindred and extended family networks.

Extended-Family-Groups and Kinship Networks in Pau Santo and São Manoel

There are many similarities between Pau Santo and São Manoel. Both communities were formed at about the same period, some eight decades ago. The initial settlers, and those who subsequently arrived have similar racial and ethnic backgrounds. From the establishment of the villages and up to the late 1950s, both communities were characterized by the formation and development of a peasant society. Pau Santo and São Manoel also experienced subsequent periods of economic differentiation (late 1950s to late 1970s) and social stratification (late 1970s to late 1980s). People in both communities were oppressed to the point of revolt against better-off ranchers, and peasants in both places struggled for their tenure rights. Settlement projects were installed in the late 1980s, marking the beginning of the current period of transformation in the socio-natural ensembles that include these two communities. In addition, Pau Santo and São Manoel are geographically close to each other, sharing similar biophysical attributes. Both are located in the same municipality, and therefore are subjected to the same

governance. Agriculture, babassu extraction, and cattle herding are carried out in both communities, using similar technologies. Yet, Chapters 3 and 4, and the discussion just presented in the last section, attest to substantial differences between the two.

I have argued that neither the duality between scarcity and abundance of resources, nor the level of social organization of each community, should be treated as the ultimate cause of these outcomes. Indeed, I suggest that improved land-use planning, as part of a more cohesive operation of local institutions of governance, requires a state of affairs in which harmony and internal cooperation supersedes discord. Accordingly, I have studied the internal structure and composition of the two communities, and concluded that São Manoel has a more solid and connected network of relatives and kin, compared to Pau Santo. Stronger and more complex kinship networks, and multiple instances of social interaction, attenuate disagreements over specific issues and subjects.

Differences between the communities in terms of their internal structure and composition are first evident in the longevity of residence, meaning the time that male and female heads of nuclear households reside in the village. While the average length of settlement in São Manoel is nearly 30 years for males and 25 years for females, average residence in Pau Santo is considerably shorter: 20 years for males and 17 years for females. These differences are not captured when we simply compare the age-structure of the two communities, as average ages for both men and women are statistically similar.

Table 7-1 shows these data, and a more elaborated comparison between age structure and time of residence in Pau Santo and São Manoel. In addition to depicting the entire communities, the table examines the subset of individuals who are at least 40 years old. The average age in the 40 and over subsets for Pau Santo and São Manoel is once

again similar. However, the older residents of São Manoel (both males and females) have lived in the community for a longer time. The data show that they are settled there an average of 14 years longer than Pau Santo's older residents. Interestingly, this means that on average, older residents in São Manoel moved to the village in the mid 1960s, compared to the late 1970s for Pau Santo. As discussed in the sequence, this difference is due to differential responses to critical socioeconomic and ecological events that took place in the communities at that period.

Table 7-1. Age structure and longevity of residence in Pau Santo and São Manoel

	São Manoel		Pau Santo	
	Males	Females	Males	Females
Entire community				
N	105	111	79	86
Average age	41.7	38.5	43.8	39.5
Average years living in the community	29.5	25.3	19.4	17.2
Individuals 40 years and older				
N	49	45	46	37
Average age	55.2	53.7	54.2	53.7
Average years living in the community	35.8	34.0	21.7	20.9
Percentage of life in the community	67.3%	65.2%	42.2%	39.4%

Source: Socioeconomic survey, 2001

Genealogies provide another way to compare the internal structure of these communities. I examined and sketched the genealogy of all nuclear families in Pau Santo and São Manoel (although the peripheral villages around São Manoel were not included in this analysis). My objective was to compare the existence of extended-family-groups, or nuclear households that are related to each other through direct descendents or marriage. A nuclear household may be part of more than one extended-family-group. The largest and oldest family-groups span up to four generations in the area. Therefore, the positioning of a nuclear household as first, second, third, or fourth generation will determine the number of connections, or links, with other families, and its participation in

one or more of such extended-groups. I have established a threshold of at least six connected nuclear families to constitute an extended-family-group. Table 7-2 summarizes the size and number of generations of extended-family-groups in both communities.

Appendix E shows genealogies of the larger extended family-groups in São Manoel.

Table 7-2. Size, longevity, and internal connections of extended-family-groups in Pau Santo and São Manoel

Name of family-group	First arrival in village	Generations in village	Nuclear households in extended-group	Cumulative households of village	Extended groups with direct links
São Manoel					
I. Livramento	1958	4	15	15 (17%)	II, III, IV, V, VIII, IX, XIII
II. Soares	1949	3	14	24 (27%)	I, III, IV, VI, IX, XIII
III. Vieira	1953	4	13	35 (39%)	I, II, VII, XII, XIII
IV. Herminio	1958	4	12	43 (48%)	I, II, VII, IX, X
V. Sousa	1953	4	11	52 (58%)	I, VIII, IX
VI. Vital	1958	3	11	60 (67%)	I, II, VII, VIII, IX, X
VII. Lima	1956	2	11	63 (71%)	III, IV, VI, VIII
VIII. Araújo	1945	3	10	65 (73%)	I, IV, V, VI, VII, X
IX. Nogueira	1952	3	10	72 (81%)	V, VI, XIV
X. Enedino	1970	3	8	74 (83%)	I, IV, VI, VII, VIII, XI
XI. Barbosa	1960	3	7	80 (89%)	I, X
XII. Pereira	1948	4	6	83 (93%)	III, XIII
XIII. Pacifico	1940	4	6	83 (93%)	I, II, III, XII
XIV. Mesquita	1970	2	6	84 (94%)	II, IV, VI, IX
Pau Santo					
I. Nascimento	1959	3	9	9 (10%)	II
II. Conceição	1976	3	8	16 (18%)	I
III. Pereira	1966	3	7	23 (26%)	IV, V
IV. Paiva	1971	2	6	27 (30%)	III
V. Evangelista	1996	2	6	32 (37%)	III

Source: Socioeconomic survey, 2001

Only five of such extended-family-groups were formed in Pau Santo. Moreover, none of the groups was formed by more than 10 households. Only three nuclear families in Pau Santo belonging to these extended-families constitute the third generation of their respective groups, which denotes a relatively “young” social network. Taken together, these five groups include only 37% of Pau Santo’s nuclear households (32 out of 87 households), indicating a fairly heterogeneous kinship basis for the community.

In contrast, the village of São Manoel presents 14 extended-family-groups formed by at least five nuclear families. Nine of these groups are formed by 10 or more households. Taken together, these 14 groups include more than 94% of the village's nuclear households (84 of the 89 households). In addition to being more extensive, the social fabric internal to São Manoel's is more mature. All but two of these groups include at least a third generation of adult household heads, and six groups are already in the fourth generation. A total of 35 nuclear households are third or fourth generations of their extended-family-groups.

Even more valuable is the visualization of internal links and relationships among extended-family-groups. The study of genealogies show a more connected and complex kinship network in São Manoel than in Pau Santo. The last column in Table 7-2, which is presented in more detail in Table 7-3, gives an idea of the contrast between communities. The number of inter-familiar connections in São Manoel is markedly greater than in Pau Santo. My conclusions are based on the following. First, they are based on the range of extended-family-groups directly connected to each other. Each of the extended-groups in São Manoel has direct kinship connections with at least two other groups. Ten of them are connected to at least four other extended-groups, thus composing a much denser network. In Pau Santo, the greatest number of connections between one extended-group and another is two. The absolute number of direct connections between extended-groups through inter-family marriages is 68 in São Manoel (average of 4.9 connections per group), and only 4 in Pau Santo (average of 0.8 connections per group). The existence of a more complex kinship network in São Manoel is also supported by indirect connections, as is the case when one extended-family-group anchors the relationship

between two others. While such indirect connections consolidate the density of internal social relations in São Manoel, connectivity among extended-family-groups is not a significant factor in Pau Santo.

Table 7-3. Connectivity among extended-family-groups in São Manoel and Pau Santo

São Manoel	I	I	I	I	V	V	V	V	I	X	X	X	X	X	X
		I	I	I	V	V	V	V	I	X	I	I	I	I	V
II	5														
III	2	2													
IV	1	3													
V	2														
VI	2	3													
VII			3	4		1									
VIII	3				4	1	1								
XIX					2	1									
X	1			1		1	1	5							
XI									1						
XII			3												
XIII	1	1	6						2			2			
XIV		1		1		1									

Pau Santo	I	II	II	I	V
II	1				
III					
IV			1		
V			2		

Source: Socioeconomic survey, 2001

Contrasting kinship structures in Pau Santo and São Manoel influenced the internal balance of economic and political power, and the entire social environment in these communities. The incidence of marriages with outside partners is proportionally greater in Pau Santo than in São Manoel. More importantly, while outside partners in São Manoel are predominantly women (in a 3:1 ratio), the proportion of male outsiders who arrive in Pau Santo through marriages is the same as that for females (1:1 ratio), and more than three times greater than the proportion in São Manoel (31% against 9%). Consequently, despite São Manoel's comparatively less land and resources, the assimilation of newly formed nuclear households occurs with little turmoil in the community. In most cases both partners are already part of the local social fabric. When

one of the partners is an outsider, the fact that most are female attenuates disputes over material and symbolic resources otherwise associated with the arrival of males from other locations. The latter situation, indeed, is more frequent in Pau Santo. As Table 7-4 shows, the greater proportion of male outsiders among the younger generation (married couples in which the husband is younger than 40 years-old) requires a continuous process of internal readjustments that creates tension and reinforces opportunities for conflict.

Table 7-4. Insiders and outsiders in marriages in Pau Santo and São Manoel

	São Manoel		Pau Santo	
	N	%	N	%
Total marriages (male younger than 40)	33		29	
Both partners from the community	21	(64)	15	(52)
Female is an outsider	9	(27)	5	(17)
Male is an outsider	3	(9)	5	(17)
Both partners are outsiders	0	-	4	(14)

Source: Socioeconomic survey, 2001

The Criticality of Permanence or Relocation

São Manoel is a community with comparatively larger and more connected extended-family-groups than Pau Santo. This is a direct consequence of critical events that occurred in the late 1960s and early 1970s. These events concern the ways in which residents of the two communities experienced the process of economic differentiation. During that period, peasant families in São Manoel endured the growing concentration of land and wealth. Most of Pau Santo's residents, however, decided to move out of the community. These differential responses were, on the one hand, influenced by previous historical trends in the communities. On the other hand, these responses set the stage for the socio-natural trajectories adopted in both communities, with consequences for the land-use strategies that people adopted.

By carefully examining the socioeconomic background of Pau Santo and São Manoel, it is possible to identify a sequence of contrasting developments decisively

accounting for the differences in today's configurations. The first was during the initial period of land occupation, from the late 1920s to approximately 1950. In this period, when occupation was restricted to Maranhenses, a more complex social hierarchy was formed in Pau Santo than in São Manoel. As mentioned in Chapter 3, while Antonio Bernardo, who was São Manoel's founder, was unable to effectively establish his family in the area, José Rodrigues was more successful in his economic undertakings in Pau Santo. In São Manoel, during the 1930s and 1940s, a sort of political vacuum allowed the initial development of a relatively egalitarian socioeconomic configuration. Contrarily, Augusto, who was José Rodrigues son, became the political and economic chief, or the coronel of Pau Santo and neighboring villages.

Because they either did not desire, or were not able to improve their socioeconomic status during the two decades after the formation of the village, the residents of São Manoel at the time did not sufficiently enforce their settlement rights. When families of Cearense and Piauiense migrants arrived in São Manoel in the 1950s, they encountered an open terrain to establish a relatively unconstrained, free peasant society. Today's largest extended-family-groups in the community (the Livramento, Soares, Vieira, Hermínio, Sousa, and Lima) date back to those early days. In the course of five decades in São Manoel, these families became hegemonic in the social composition of the community, superseding the older Pacífico, Pereira, Silva, and Ferreira families. Most importantly, these families perceived themselves as entitled to the land and resources they worked, ignoring landlord claims. Furthermore, at least one member of each of those extended-family-groups was able to accumulate resources that,

although limited, provided an economic base that supported the extended-family-group, enabling them to endure the subsequent period of land struggle.

In Pau Santo, on the other hand, the political and economic control long exerted by Augusto Rodrigues inhibited the formation of an expanded egalitarian network of peasant families. Faced with the political centralization imposed by Augusto Rodrigues, migrant settlers sought other places to settle. Those who remained in Pau Santo established social roots in the village, often in a subordinated position. Unable to accumulate even limited wealth, they remained in precarious socioeconomic circumstances. When faced with state initiatives to transfer land to outside ranchers, most of those families simply opted to leave Pau Santo.

The second contrast between São Manoel and Pau Santo was therefore the manner in which the concentration of land and wealth took place, and, in addition, how local families adapted to this process. Since the 1970s, the individuals who enlarged their landholdings in São Manoel were Adelino, and, to a smaller extent, José Nogueira. Both were part of the community, and were themselves members of extended-family-groups that today still play a prominent role in São Manoel's social structure (groups IX and XI, in tables 7-2 and 7-3). With no means to promptly contest the economic expansion of the better-off, the residents of São Manoel never perceived Adelino's and Nogueira's claims to larger holdings as legitimate.

In Pau Santo, by contrast, land privatization in the 1960s prompted by the actions of the state, and transfer of private property to Wilson Maciel and Nilson Silveira in the 1970s aggravated pressure on a large number of families who had long experienced conditions of domination. In the 1950s, Pau Santo was already one of the largest villages

in the region. Therefore, it is important to understand that a massive departure of Pau Santo's early residents (to other lands in Maranhão and further west) took place during the 1960s. Although some of these families later returned, most of them left for good. Upon the departure of these families, a contingent of other families moved to Pau Santo in the late 1960s and 1970s, mostly at the invitation of foremen working for the new landowners. Although offered land to work, they ultimately served as a labor force in the conversion of forest to pasture and the planting of jaraguá grass while cultivating their roças. Thus, before the agrarian conflict, the families that today constitute the great majority of Pau Santo's population were never legitimate owners of the land. The few families that endured the process of land privatization, on the other hand, were similarly denied full access to their land claims. During the time spent in Pau Santo, neither of these groups experienced the condition of being part of a truly free peasantry.

Differences in present socioeconomic configurations can thus be traced to the early stages of community formation. By progressively connecting these historical facts, we are able to grasp the explanations for São Manoel's more consolidated occupation, and extended kinship networks that resulted in more harmonious social relations. In the case of São Manoel, consolidated and unified kinship networks served to unify community members and attenuate their differences. Such a network functioned to avoid extreme conflicts and the open manifestation of violent events, allowing a social environment in which common interests can be achieved. In Pau Santo, on the other hand, a rather distinct perspective characterized the social positioning of local residents, who felt more constrained in their social and economic life. These families ultimately rebelled against oppression, and, through collective action, were able to access land and

resources. However, they did so through a loose kinship network, embedded in a social composition that was much broader and differentiated. Therefore, once the struggle against outside ranchers was over, there were no previous practices, nor was there sufficient time to exercise mechanisms to resolve internal conflicts. The consequence was greater competition and the individualization of objectives, the periodical resurgence of discord and violence, and an omnipresent feeling of social insecurity. Before concluding this chapter, in the next section I discuss in more detail another aspect related to extended-family-groups that denotes the contrasting ways in which residents of the two communities experienced economic differentiation.

The Importance of Material Support from Extended-Family-Groups

If kinship structure and internal composition are key factors that influence the socioeconomic configuration of each ensemble, another feature related to more consolidated social networks of extended-family-groups, and critical for the connectivity within peasant communities, is the benefit provided by improved material conditions. Indeed, assets and property owned by members of extended-family-groups played a critical role by allowing their kindred to endure periods of hardship. The support of family members who accumulate resources may enable an entire community to get through difficult times. The support of better-off extended-family members in São Manoel proved to be decisive for the differential trajectory of the community. These private properties contributed to harmonize social relations within the community during the period of land struggle, and after it.

Residents of Pau Santo who were landowners during the onset of the land conflict were Zequinha Rodrigues (75 hectares), Vicente Ferreira (35 hectares), Cecílio Gomes (140 hectares), and Evangelio Cardoso (191 hectares). In addition to them, Antonio

Batista (10 hectares) and Antonio Raimundo (33 hectares) owned land in more distant locations. None of them, however, were part of the largest extended-family-group in Pau Santo. The first three families mentioned above even positioned themselves against the struggle for land and in favor of the ranchers' interest. By the mid-1980s, these three properties were almost entirely converted to pasture. After the conflict, and up to the present day, no one else in Pau Santo purchased private property. This is partly explained by the relatively abundant area of the settlement projects in Pau Santo and Vila São João.

In São Manoel, on the other hand, at least one member of eight of the largest family-groups owned land near the village. Antonio Soares was the owner of 90 hectares that shared boundaries with the property that was later expropriated. Joaquim Araújo's 58-hectares, and the Barbosa brothers' 102 hectares were also part of São Manoel's lands. Florismino Vieira was in possession of 26 hectares, while Antonio Vital, and Antonio Herminio (with one of his sons) had each purchased 20 hectares. The Sousa family owned land in the neighboring village of Centro dos Custódios, and Genário Lima also purchased 10 hectares. Except for the Barbosas and the Araújo's, all the other families played critical roles during the land struggle. After the resolution of the conflict, several other São Manoel residents gained access to small tracts of land, forming a group of 35 private landowners, with a total area of 970 hectares (see Table 3-2).

The importance of these private lands can be appreciated at two distinct moments. Initially, private landowners were able to support themselves, and other families, during land struggles. Their land served for the cultivation of small roças and other crops that ensured the survival and reproduction of the group during the years when people were barred from São Manoel's settlement land. Those who owned cattle also supplied meat

during critical periods. Even the provision of a safe hiding and sheltering place was critical during the peak of the conflict. The practice of these peasant landowners, by allowing families to use their property and resources, created a strong norm of reciprocal attitudes and consensus. Such notions of collective welfare were then transmitted to subsequent challenges to their common undertakings.

Private lands fulfilled a rather different role in a latter period, when land conflict was over and the state installed a settlement project with collective landownership. In São Manoel, the availability of private lands owned by the relatives of peasants directly benefited by the settlement project, turned out to be critical to a more balanced livelihood system within the entire community. Those whose families owned private lands already had access to resources that guaranteed their survival. Of course there were cases in which the head start of certain households contributed to greater inequality. In the particular case of São Manoel, however, it contributed to social harmony.

This is particularly relevant for situations that involve the management of collective goods, in which a permanent struggle exists between the priority given to individual or collective benefits. In social groups with diverse levels of commitment and expectations, those in charge have a rather difficult administrative task. The case of São Manoel, however, involved administrators, or community leaders who had access (through extended-family-links) to additional private property. These assets enabled them to forego part of their benefits to benefit the community. During initial stages of the settlement project, these individuals consciously opted to rely less on the collective resources. In doing so, they transferred a greater share of these benefits to other producers who had no private land, indirectly redistributing goods and services within the group.

The same did not occur in Pau Santo, where the size of the land where the settlement was installed prevented the need to purchase additional property. The absence of private property arguably directs all the expectations towards the common land, creating a social environment characterized by enhanced disputes over rights and resources.

Life History of Community Leaders as Examples of Contrasting Situations

A brief examination of the life history and livelihood of José Soares, a community leader in São Manoel, serves to demonstrate the importance of the factors presented in this chapter. José, married to Teresa Livramento, is a 53-year-old father of three sons and three daughters. José is considered to be one of the more influential individuals among the rural workers of Lago do Junco. His influence has spanned from the time of the land conflict, to the formation of the local association and cooperative, to the present day when those institutions became consolidated. Although José never occupied leadership positions in broader institutions, his opinions have always been considered during decisive moments of key political decisions in São Manoel and in the municipality.

José's late father, Antonio, had always contested his son's active role during the land conflicts, and even moved out of the village during the struggle. During the peak of the struggle, Antonio Soares stayed with his brother, who owned land in Primavera, a village located some 5 miles from São Manoel. Despite his father's reaction, José's nuclear and extended families have been supportive of his attempts to regulate social relations in the community. As the older son of the Soares family, José was able to benefit from the resources of his father's 90-hectare land.

Originally from Piauí, Antonio Soares settled in the area in the 1940s. Although their original land entitlements were larger, the Soares family was able to register private land in the 1960s, assisted by José Nogueira, who arguably kept a share of their land

rights. Approximately half of this property was converted to pasture, while the other half remained for shifting-cultivation. Even today, when land for cultivation in São Manoel is scarce, José and three other family-members that participate in the settlement project (brother, son, and brother in law) crop at least part of their roças on that private land. In addition, the Soares family's previous experience with cattle ranching served in several instances to support and orient the common herding initiative undertaken by São Manoel's association.

There is also a great deal of collaboration and labor exchange within José's extended-family-group. The Soares and the Livramento are the largest family-groups in São Manoel, and even though José has a chronic illness that limits his work in the field, help from his children and in-laws is enough to provide for his family. Maria, one of José's daughters, spent four years working as housekeeper in Brasília. In 2001 she returned to live with her parents. Upon her return, Maria added several assets to the family, who now own a refrigerator, color-tv and satellite dish, and better-quality furniture. Another of José's daughter still works in Pedreiras, also as a housekeeper, and constantly visits with the family.

Although I have used the example of José Soares, there are at least three other leaders in the community of São Manoel who show life histories and livelihoods that resemble the above description. These are Raimundo Hermínio, Raimundo Vital, and Milton Vieira, each one belonging to an influential extended-family-group. Together with José Soares, they validate the notion that the most critical figure of peasant uprisings is the "middle-peasant" (Wolf 1969). By examining the case of São Manoel, I argue for expanding the importance of these "middle-peasants," and their extended family-groups,

beyond rebellion, to include the consolidation of a viable peasant social system in situations of constrained resources.

In São Manoel, the assets and characteristics of the Soares family allowed José to dedicate himself to the organization of common undertakings during and after the land conflicts. In Pau Santo, a rather diverse condition characterized Milton Monteiro, Pau Santo's most active community leader during the struggle. Milton's father, Manoel Monteiro, was killed by the police regiment that entered Pau Santo in 1985. But the difference between Milton and José's families can be traced to the 1960s.

Contrary to the late Antonio Soares, Manoel Monteiro did not believe in the need to register the land they had occupied in Pau Santo since 1947. Indeed, Manoel left Pau Santo in 1960, when Milton was 17. Manoel Monteiro established his family in the forested lands of Brejo Grande, in Altamira, a municipality in the Grajaú Valley. After a few years, Milton married in Brejo Grande. Therefore his in-laws were not residents of Pau Santo. But because in 1967 Milton's father-in-law was involved in a murder, they all had to live Brejo Grande. Milton accompanied his in-laws to their original village in Coroatá, an area of older colonization in the Itapecuru valley, east of the Mearim. They spent four years in Coroatá, before eventually returning to Pau Santo in 1971. By that time, Manoel Monteiro also had moved back. However, they were never able to validate their original land claims. Upon their return they became village residents, subordinated to the recently arrived landowners.

Milton's wife passed away ten years ago, causing disturbances in the family's livelihood. Milton is now 57. Constant duties during the last decade provoked frequent absences from the house, which affected the children's education. Milton has three sons,

who are younger than José's. None of them has married. His only daughter, now 31, left for Fortaleza in the mid-1990s, only to return after three years with an unemployed partner who had no experience working the fields, and three stepchildren. All now live in Milton's house. The house itself reflects the struggle that the family has been through. Although made of brick, tile, wood, and cement provided by INCRA's habitation project, anyone entering Milton's house immediately senses the disorder and stress. The situation was made worse by Milton's chronic illness. Despite his leadership role, his poor health and difficult economic situation meant that he had to devote more time to his family's survival, and less to community affairs. As a result, his influence and the trust that the community deposits in him gradually declined.

Milton's trajectory was a clear example of the way people's family and personal lives affect community development. Similar processes occurred among other community leaders in Pau Santo. None of these were members of an extended-family-group that provided them material support, or at least a reasonable dose of insurance for their activity on behalf of communal interests. All of those that followed Milton as a director of Pau Santo's association of producers also had to struggle with quarrels that affected the internal relations of their own families within Pau Santo. In addition, suspicions arose concerning their role as resource-managers. Therefore, as Milton's leadership began to be contested, none of those who replaced him has acquired the social capital needed to become a major force in the community.

Conclusion: Situating an Ordered Causality for Differential Outcomes

Socio-natural developments in Pau Santo and São Manoel should be explained by the interplay of the domains of explanation discussed in Chapter 2. By applying complementary methods and different levels of theoretical abstraction, it is possible to

recognize the interplay of individual rationality, structural, relational, as well as ecological and symbolic dimensions in influencing major developments in these communities. The interplay of these domains affects the way resource-use strategies are prioritized, and ultimately define the specific forms through which humans interact among themselves and with the environment. My objective in this chapter, however, was to trace the factors that, in my view, led to collaborative efforts in São Manoel, and to the less organized land-use planning witnessed in Pau Santo.

The discussion has emphasized the importance of internal cohesion within peasant social systems. I have shown the extent to which discord and distrust in places like Pau Santo were latent issues that affected the community's ability to deal with external shocks. By studying the genealogy of family groups in both communities, I noted that collaborative relations in São Manoel were partly due to the larger and more consolidated kinship and social networks. Finally, I argued that such developments were the result of the histories of social positioning that characterized critical moments in the construction of the socio-natural ensembles in Pau Santo and São Manoel. Of particular relevance in this respect were Pau Santo's greater social hierarchy and centralization during the initial period of land occupation, and the permanence of São Manoel's residents during the time in which land was privatized and social cleavage more pronounced. Comparing the life histories of residents of São Manoel and Pau Santo at the time of land struggle, while the former constituted a truly free peasantry, the latter occupied a rather subordinated condition.

I make no claim that the above features were the only factors implicated in the distinctions between resource-use allocations in these communities. However, the

exercise of progressively tracing the connections among those features served to identify some key factors that produced alternative outcomes at the community level.

As discussed along this study, there is no single path characterizing the socio-natural trajectory of peasant communities. In line with the analytical and theoretical frameworks of a grounded political ecology, the diversity of transformations in socio-natural ensembles can only be assessed through the integration of multiple explanative domains. Because the expansion of cattle ranching is one of the most controversial contemporary socio-natural processes taking place among peasant producers in general, and within the communities of Pau Santo and São Manoel in particular, the next chapter applies the framework to assess the multiple dimensions involved in this phenomenon.

CHAPTER 8

GROUNDING POLITICAL ECOLOGY OF RANCHING EXPANSION

The partial re-conversion of pastures to second-growth and shifting-cultivation, combined with the expansion of the ranching activity within common and private lands of peasants were important transformations in the socio-natural ensembles of Lago do Junco in the 1990s. The expansion of small-scale cattle ranching, however, has been different in each community, varying according to their specific socioeconomic and biophysical configurations. In São Manoel, for example, raising a collective herd in common pastures managed by the association of producers was critical for the gradual improvement in household socioeconomic status. The expansion of economic horizons for both settlers and private landholders in São Manoel has been carried out through increased investment in the activity, a process that is reflected by the broader dissemination of cattle ownership among households, and the acquisition of small private properties to secure additional land for the overflow of individual herds. In Pau Santo, ranching assumes rather different features, still denoting class and power distinctions, and manifested through the dissemination of private and illegally fenced areas within common lands. In effect, the multiple forms and diverse management practices through which the activity has been embraced by those who explore small landholdings is part of a broader trend that is not restricted to the Mearim Valley, or to the state of Maranhão. To a great extent, variations in how the ranching activity has been adopted by peasants reflect the integration of multiple processes and events that are at stake, and which can only be correctly assessed through a combination of research approaches.

With this objective in mind, in this chapter I present an in-depth analysis of the expansion of ranching in peasant communities of Lago do Junco. I employ the analytical and theoretical frameworks presented in the first two chapters, and draw upon insights gained while interviewing small- and large-scale cattle ranchers in other parts of the Mearim and Pindaré Valleys. Instead of identifying a single underlying principle to explain ranching expansion in Lago do Junco, the discussion consists of an integrative approach that accounts for the interplay of factors that, at different spatial and temporal scales, and according to different but complementary domains of explanation, lead to a complex socio-natural transformation. Before carrying out the analysis, I provide quantitative references revealing specific aspects of the expansion of small-scale cattle ranching in Maranhão, and in Lago do Junco, noting that a general characterization of this small-scale cattle ranching was presented in Chapter 4.

Ranching Expansion in the Brazilian Legal Amazon and in Maranhão

The expansion of cattle ranching, particularly in the Brazilian Amazon, has been often associated with harmful socioeconomic and ecological outcomes (Browder 1988; Fearnside 1997; Hecht 1993; Reis and Margulis 1994). Higher indexes of concentration of landownership, greater economic inequality, and worse environmental conditions are usual features brought up in the analyses of conversion of forested or agricultural lands to pasture, and of state incentives to the ranching activity. There is no doubt that the ranching activity is pursued by dominant social strata in rural Latin America. In the Brazilian Amazon, for example, official statistics show that the majority of the cattle herd is being raised on disproportionately large landholdings. However, the 1985 and 1996 Brazilian agricultural censuses pointed to the growing number of small landholders who are engaged in the ranching activity. Consequently, cattle began to exercise an important

role in the livelihood strategies of a significant stratum of resource-users who previously had been only marginally involved in ranching.

In the state of Maranhão, the expansion of cattle ranching has occurred at a steady pace since the 1960s. Table 8-1 shows that, although Maranhão's 1996 cattle herd represented only 11% of the regional total, the state comprised 24% of the cattle raised on landholdings smaller than 50 hectares in the Legal Amazon.

Table 8-1. Total and percentages of 1996 cattle herds in states of the Brazilian Amazon by groups of landholdings according to their size

Size (ha) of landholdings	AC	AP	AM	MA	MT	PA	RO	RR	TO	Amazon
< 10	4,609 0.5%	587 1.0%	53,016 7.2%	379,997 9.7%	53,886 0.4%	84,779 1.4%	56,774 1.4%	9,214 2.3%	9,766 0.2%	652,628 1.8%
11-50	54,625 6.4%	1,459 2.4%	161,238 22.0%	403,030 10.3%	583,078 4.0%	459,043 7.5%	496,380 12.6%	3,631 0.9%	192,266 3.7%	2,354,750 6.6%
51-200	264,668 31.2%	10,719 18.0%	225,522 30.7%	949,709 24.3%	1,492,770 10.3%	1,378,250 22.7%	1,509,006 38.3%	66,459 16.6%	727,449 13.9%	6,624,552 18.6%
201-1,000	185,271 21.9%	25,085 42.0%	167,960 22.9%	1,176,478 30.1%	2,965,503 20.5%	1,486,598 24.4%	965,648 24.5%	99,440 24.9%	1,768,881 33.9%	8,840,864 24.8%
1001-10,000	262,951 31.0%	21,729 36.4%	99,970 13.6%	842,560 21.6%	6,230,969 43.2%	1,998,686 32.9%	700,954 17.8%	179,097 44.8%	2,215,753 42.5%	12,552,669 35.2%
> 10,000	75,084 8.9%	121 0.2%	26,204 3.6%	142,681 3.7%	3,111,929 21.6%	671,361 11.0%	208,529 5.3%	41,939 10.5%	300,292 5.8%	4,578,140 12.9%
Not informed	0	0	0	8,154 0.2%	0	1,714	0	159	3,735 0.1%	13,762 0%
State total	847,208	59,700	733,910	3,902,609	14,438,135	6,080,431	3,937,291	399,939	5,218,142	35,617,365
% of Amazon	2.4%	0.2%	2.1%	11.0%	40.5%	17.1%	11.1%	1.1%	14.7%	100.0%

Source: IBGE 1998.

Today, Maranhão's cattle herd has surpassed four million head. Given the relatively large percentage of cattle raised on those small- and mid-size landholdings, it is evident that peasant producers have integrated ranching and pastures into their socioeconomic and biophysical configurations. Table 8-1 also shows that by 1996, 45%

of Maranhão's cattle were raised in landholdings smaller than 200 hectares, and 20% took place in areas not larger than 50 hectares. These latter numbers stand in sharp contrast to the significantly lower percentages recorded in Rondônia (14%), Pará (9%), Mato Grosso (4.5%), and Tocantins (4%). These states, together with Maranhão, contain 95% of the cattle herd in the Legal Amazon.

Further observations concerning the distribution of cattle ranching by size of rural landholding reveal other aspects of the transformation in the socio-natural ensembles in rural Maranhão. Although 85% of the state's 370,000 landholdings have less than 50 hectares (IBGE 1998), only 20% of those are currently engaged in ranching. As noted in more detail in Table 8-2, the proportion engaged in cattle ranching was 30% among landholders with 5-10 hectares. The proportion increases to 40% among those with 10-50 hectares, rising to 80% among landholders with over 200 hectares. Table 8-2 also compares variations in the average cattle herd between 1985 and 1996 by groups of landholdings according to their size. Excluding the two extreme groups,¹ the data show that the greater increase in average cattle herd took place for the group of smaller landholdings. The average herd in landholdings between 5 and 10 hectares rose from 13 to 22 cattle (69%). Increases from 17 to 25 cattle (47%), and from 33 to 49 (48%), were respectively observed for landholdings between 10 and 50 hectares, and for those between 50 and 200 hectares. Increases by 54 and 55% were respectively noted for groups of landholdings between 200 and 1,000 hectares, and for those between 1,000 and 10,000 hectares.

¹ Landholdings smaller than 5 hectares were excluded because they are too small for effective herding activity; those with more than 10,000 hectares were excluded because of their limited number.

Table 8-2. Landholdings engaged in cattle ranching; total and average cattle herds by groups of landholdings according to their size

Size (ha) of landholdings	Landholdings engaged in cattle ranching and percentage in relation to total landholdings						Cattle herd: total and average herd by group of landholding size					
	1960		1985		1996		1960		1985		1996	
	Number	%	Number	%	Number	%	Herd	Avg.	Herd	Avg.	Herd	Avg.
< 5	29,745	(13.9)	54,035	(12.6)	43,130	(16.4)	397,067	(13)	375,579	(7)	317,270	(7)
5-10	4,532	(28.0)	4,636	(29.5)	3,075	(31.1)	94,611	(21)	58,279	(13)	67,727	(22)
10-50	6,217	(38.9)	15,470	(43.3)	16,449	(41.8)	183,008	(29)	258,953	(17)	403,030	(25)
50-200	5,031	(57.4)	20,676	(62.0)	19,233	(61.6)	197,963	(39)	676,662	(33)	949,709	(49)
200-1,000	4,547	(71.9)	9,193	(82.2)	7,655	(79.8)	288,096	(63)	921,647	(100)	1,176,478	(154)
1,000-10,000	1,211	(81.6)	1,983	(87.5)	1,320	(81.1)	161,348	(133)	814,549	(411)	842,560	(638)
> 10,000	38	(95.0)	61	(80.2)	36	(67.9)	16,373	(431)	116,932	(1917)	142,681	(3963)
Not classified	430	(65.1)	846	(22.7)	931	(6.5)	42,045	(98)	24,605	(29)	8,154	(9)
Amazon	51,751	(19.8)	106,900	(20.1)	91,829	(24.9)	1,380,511	(27)	3,247,206	(30)	3,907,609	(43)

Source: IBGE 1966, 1990, 1998.

The total herd in Lago do Junco by the year 2000 was 8,325 cattle (IBGE 2001b). Although the 1996 agricultural census still included Lago dos Rodrigues within the data for Lago do Junco, Table 8-3 demonstrates the process I used to estimate that this herd was comprised within 175 landholdings, or 18% of the landholdings in Lago do Junco. In addition, the 1996 census shows that 65% of the land in Lago do Junco's landholdings (estabelecimentos rurais) was converted into pasture² by the end of 1995.

A more detailed source of information about the ranching activity is the records of the state extension service office that monitors foot-and-mouth disease, summarized in Table 8-4. In the year 2000, the area of pasture and the composition of herds owned by 87 ranchers registered in Lago do Junco were examined. Records for these 87 landholdings engaged in ranching (corresponding to half of the ranching landholdings estimated with the use of census data) show that a higher proportion of their land was converted into pasture, when compared to the census data. As the table shows,

² The data is probably underestimated. Lago do Junco's total area before the separation of Lago dos Rodrigues, in 1997, was 71,400 hectares (714 km²). Census data for the municipality's land-cover types, including landholdings of Lago dos Rodrigues, add only to 34,000 hectares.

landholders engaged in cattle ranching have converted their land to pasture on an average of 62% for the smaller, and 87% for the larger estates, what is consistent with the remote sensing analysis presented in Chapter 5.

Table 8-3. Estimate of landholdings engaged in cattle ranching in Lago do Junco, 1996

	Total population	Rural population	Number of households	Residents/ household	Rural households	Rural landholdings	Ranching landholdings	Cattle herd (2000)
Lago do Junco	9,833	6,933	2,120	4.64	1,494	982	175	8,325
Lago dos Rodrigues	8,443	3,963	1,893	4.46	889	585	104	12,051
Total	18,276	10,896	4,013	4.55	2,383	1,567	279	20,376

Notes: Population data and number of households (domicílios) were obtained from the 2000 demographic census (IBGE 2001a), and were used to calculate the average number of residents per household, and the number of rural households. Combined totals for rural landholdings, and for landholdings engaged in ranching, were obtained from the 1996 agricultural census (IBGE 1998). The proportions for Lago do Junco and Lago dos Rodrigues in these two columns are estimates based on their respective number of rural landholdings. The 2000 cattle herd comes from the municipal livestock production estimates (IBGE 2001b).

The composition of a total herd of 6,977 cattle (corresponding to 84% of IBGE's estimates) is also shown in Table 8-4. Forty percent of the herd was raised on 77 landholdings smaller than 200 hectares, while 15% took place in 32 landholdings not larger than 50 hectares. Most of the cattle not included in these records (or some 1,300 head) are likely to be owned by small-scale ranchers that were not reached by the extension service. Therefore, the proportion of small-scale ranching should be even bigger, probably in the range of 45-50% and 20-25%, respectively for the "less than 200 hectares" and the "less than 50 hectares" groups of landholdings.

A final remark on the composition of Lago do Junco's cattle herd confirms the low priority given to the production of milk. According to IBGE estimates, only 401 cows (or less than 5% of the total herd) were milked in the year 2000, producing an annual average of 593 liters per cow. In the neighboring municipality of Pedreiras, although annual productivity of milk is similarly low (630 liters/cow), the proportion of

cows milked corresponded to 29% of the total herd, denoting greater market insertion for this product. Indeed, the milk produced in Lago do Junco's ranches is mostly consumed locally, with limited amounts being sold in the city.

Table 8-4. Herd size, composition, and area converted to pasture in Lago do Junco, 2000

Ranching features	Group of landholders according to size of landholding				Total
	< 10	11 - 50	51- 200	> 200	
Landholdings raising cattle	9	73	45	10	87
% of total	10.3%	26.4%	51.7%	11.5%	
Total area of landholdings (ha)	69	1,071	2,191	5,317	8,648
Total area under pasture (ha)	43	856	1,630	4,628	7,157
% pasture	62%	80%	74%	87%	83%
Total cattle herd	90	992	1,714	4,181	6,977
% of total	1%	14%	25%	60%	
Average herd/landholding	10	43	38	418	80
Average herd composition	Calves	3.7	13.4	12.1	78.8
	Steers	1.4	6.9	5.2	87.2
	Heifers	1.4	7.9	6.6	158.1
	Cows	3.1	13.9	13.5	91.7
	Bulls	0.3	1.0	0.6	2.3

Source: Records obtained from State of Maranhão, Gerência Regional de Pedreiras

The statistics and census data about cattle ranching in Lago do Junco provide a rough portrait of the activity. Yet, dynamic transformations comprised by land settlement projects of the last decade are not entirely captured by these statistics. This is particularly relevant because the basic unit of analysis adopted by IBGE, which is the rural *estabelecimento*, does not reflect the total area of all landholdings. Despite such limitations, I have shown in Chapter 4 that high percentages of pasture conversion were consistent with the situation in Pau Santo and São Manoel until land conflicts erupted. I also noted that today, although these percentages were reduced, ranching and pastures are important components in the livelihood of a growing number of resource-users, especially when combined with shifting-cultivation and babassu extraction. The

remainder of this chapter thus discusses the multiple processes and events, and the domains of explanation that can be employed to analyze the diverse forms through which cattle herding has expanded among the livelihood systems of peasants in the study area.

Domains of Explanation for Ranching Expansion in Lago do Junco

A framework that explains the expansion of the ranching activity among peasants combines perspectives centered on the operation of societal broader structures, and explanations based on individual attitudes and decision-making. It also incorporates the influence of existing biophysical configurations. Arguments based on broader social structures are centered, on the one hand, on political economic arrangements, and on the other hand, on functional, or relational approaches. Political economic approaches consider economic and power relations among and within groups. Functional, or relational approaches focus on the fulfillment of social functions by ranching, and the role of these functions in relation to other sectors of society, and within the constituents of each social group.

At the individual level, the activity is perceived as fulfilling critical roles for the livelihood of peasant households. Departing from analyses that only accept large-scale ranching as profitable and competitive, the examples considered in this study indicate that small-scale ranching operations could also be viable, if the principles of peasant resource-allocation are understood. According to this perspective, favorable economic returns are possible when scale and management practices are tailored to local ensembles. Another actor-centered approach sees practices and customs involving cattle as deeply embedded in the cultural background of residents of these peasant communities, even among those who have not had a great deal of direct experience with the activity. Still another perspective emphasizes the strong symbolic features that are associated with the

activity in the region. When joining the latter two, one concludes for the particular case of Lago do Junco, that resource-users' perceptions and reactions towards ranching were initially shaped by practices prior to land and social struggles. These previous experiences left deep imprints that, although hidden during these conflicts, reappeared through routines and practices in the performing of the activity. In these routines and practices, present, past, and remote experiences constantly collide, reinforcing the symbolic component of ranching for peasant communities in the Mearim.

Frictions mark the interplay between actor-centered, and social-structural approaches. This can be observed when economic incentives and the fulfillment of social functions clash with political and ideological implications that such incentives and functions exert on the constituents of a social group. In a continuous mode, struggles hitherto observed between presumably distinct social groups encounter fertile terrain to renovate and manifest themselves within other instances of transformed socioeconomic configurations. It is thus critical to examine the extent to which individuals, households, and communities respond to symbolic and ideological factors that are intertwined with power and political structures, and with tangible economic and ecological determinants. Differential responses will ultimately influence diverse trajectories for the engagement of resource-users in ranching, which are themselves dynamically transformed by the consequences of past attitudes and practices toward the natural environment. The next five sub-sections correspond therefore to the domains of explanation that compose the analytical framework of a grounded political ecology, which in this particular case attempts to explain the socio-natural transformations represented by the expansion of cattle herding among peasants and other small-scale ranchers in Lago do Junco.

Perspectives Based on Economic Rationality

One of the most influential approaches explaining land-use transformations is based on the principles of economic rationality. The approach considers concrete factors that directly intervene in the economic allocation of resources. Interpretations of ranching expansion among peasants based on economic rationality are guided by the underlying principle that the activity is the most appropriate means to optimize benefits given the resources that are available to households. The approach acknowledges that the engagement in ranching is constrained by lack of access to the means of production (land and capital). Once this access is obtained, features commonly emphasized by such interpretations include the comparative advantage of ranching operations in the face of agricultural and extractive products, the disproportionate availability of credit for cattle ranching, the compatibility between operations for pasture conversion and annual cropping, the activity's relative low risk, low labor requirements, and the capacity of peasants to control the productive process of cattle herding. Moreover, it is the high liquidity of ranching products granted by the development of steady markets that bolsters arguments based on economic rationality.

Although formulations based on individual rationality are more commonly associated with neoclassical economics, other theories should be incorporated when peasant households are the focus. Of particular importance is Chayanov's theory explaining peasant economic logic on the basis of specific motivations to optimize their returns to labor given the demographics of their household. The main components forming the rationality approach for the expansion of ranching among peasants in Lago do Junco are presented next.

Control of the productive process

Rational engagement in ranching can be approached as a conscious choice in the face of other alternatives that did not secure the control of the productive process. As noted in Chapter 4, technological innovations were restricted and uncertain in the Mearim Valley. In contrast to the uncertainties and lack of expertise with input-dependent mechanized agriculture and perennial crops, field practices to convert secondary vegetation to managed pastures were not unfamiliar to local resource-users. To the contrary, these practices, even when not directly performed by them, have long been present in their daily routines. One can say that these peasants controlled the technology needed for the conversion of land to jaraguá pastures, and for the raising of mixed breed cattle. Therefore, when presented with an opportunity to integrate another activity into shifting-cultivation and babassu extraction, the alternative to raise cattle with these management practices is perceived as less risky than any other available option. For producers with little insurance capacity, to be familiar with the technological requirements of any undertaking represents a secure and advantageous option. For this very same reason, most of Lago do Junco peasants that engaged in ranching remain confident as long as familiar and affordable technological requirements are maintained.

The same does not apply to the introduction of techniques that are neither controlled nor can be afforded by them, as is the case for brachiaria pastures, improved genetic breeds, or technological innovations. Peasants lack the knowledge, skills, or resources to appropriately deal with such innovations. Most of them do not adopt these alternatives because they know they cannot afford them; hence running the risk of not controlling the productive process upon which they are based.

Comparative advantage in the face of agricultural and extractive products

Annual crops produced in roças are a constituent part of peasant identity in the region. Peasants' material and sentimental satisfaction when facing a good harvest transcends rational explanation. It is the search for such satisfaction that explains, for example, constant moves to remote, forested areas, even if that implies a permanent condition of relocation and the lack of place attachment. Even when resources become scarcer and their yields decrease, the cropping of annual fields is critical to household subsistence. In short, the absence of roças is perceived as severely jeopardizing the social continuity of the domestic unit. Therefore--and despite the influence of northeastern migrants who have greater familiarity with herding activities (an issue subsequently treated in this analysis)--substantial socio-natural transformations are needed to convince households to replace their annual fields with livestock.

Hence, in the last two decades a combination of powerful factors has motivated local producers to search for economic alternatives to partially replace annual crops. Among factors that led to the search for alternatives were the effects of concentration of landownership, and the fall in prices of agricultural and extractive products. The former restricted access to resources, imposed shorter fallow cycles, worsened labor productivity, and undermined the feasibility of shifting-cultivation. Those that managed to remain on the land were weakened in their capacity to provide for household needs with swidden fields alone. The fall in prices discouraged the cropping of plots larger than the minimum required for strict consumption, and prompted the search of alternative sources of income. The option to intensify agricultural practices was constrained by the lack of technological dissemination. In addition, as seen above, peasants hesitate to engage in undertakings that are largely unfamiliar and unmanageable. Cultivation of

banana, pineapple, and fruit trees had the additional risk imposed by a short-term post-harvest period to market the products--a critical factor when road conditions are unstable. These factors led to the conversion of part of the land to pasture, and to the purchase of cattle. As discussed in the sequence, this was facilitated by two factors: the disproportionate availability of rural credit for ranching, and the nature of pasture installation and maintenance, which dovetailed with the scale of operation and resources available to domestic units of production.

Availability of rural credit

Most of the local producers agree that they need external support in order to move beyond traditional systems of shifting-cultivation. They also agree that subsidized, or low-interest rural credit operations are among the most relevant sources of such external support. Land struggles in the mid-1980s coincided with a period of retraction in the supply of rural credit in the Legal Amazon. Macroeconomic problems in Brazil had forced a reduction in these operations, which had played a crucial role in the dispossession of the peasantry by ranchers all over the region. Paradoxically, when rural credit regained strength in the early 1990s, it was largely channeled to the benefit of small- and medium-sized landholders, most of them in settlement areas receiving PROCERA (Chapter 3). More striking is the fact that, except for small PRONAF contracts in support of annual crops, the majority of the contracts involved investment in ranching. As noted, this was partly due to the lack of concrete experiences with other agricultural initiatives. Bank representatives and extension agents used such a lack of experience to justify the priority they gave to ranching contracts, supported in their turn by an existing "culture" of ranching projects. From the bank's standpoint, it was safer to lend money to build fences, convert land to pasture, and buy cattle.

Banco do Brasil, and Banco do Nordeste do Brasil (BNB) are the financial institutions that managed rural credit in the region. These institutions have distinct agendas for the application of rural credit resources, at least in the Mearim Valley. Operating with a branch in Lago da Pedra, Banco do Brasil is responsible for the application of PRONAF credit for the traditional cultivation of annual crops. On the other hand, BNB--which was responsible for some 75% of the rural credit operations in Northeast Brazil in 1999--emphasizes the introduction of technological change among mini, small, and medium landholders. With a branch in Pedreiras, BNB has a clear mandate to restructure ranching operations, stimulating production units to mix dairy breeds to beef cattle. In addition to settlement areas benefited with PROCERA credit, BNB also assists individual landowners that form small groups for the co-presentation of their projects. The reappearance of rural credit, and particularly the opportunities available to peasants and small landholders have been critical in a process where ranching activities became part of a strategy to augment their access to capital. However, as discussed later, credit support has also reinforced the expansion of cattle herding through their insertion in broader processes of negotiation of power.

Pasture formation and the agricultural cycle

While pasture formation implies heavy costs for larger enterprises, it represents a relatively small increment to labor and capital expenditures among resource-users who are engaged in annual cropping using shifting-cultivation technology. Rather than an isolated operation, the process of pasture conversion among small landholders consists of an additional step to their cropping. Pasture grass is sowed during the last weeding of fields cropped with rice, maize or beans. By progressively converting small areas to pasture in this way, resource-users reconstitute on their behalf a strategy that was used

before by the ranchers that evicted peasants from the land. In those instances (in which tenure rights were not recognized and the subjects were viewed as sharecroppers), producers are locked into a system that compels them to be the direct agents of their own demise by limiting the amount of land available for crops. Under the new scenario, better-off peasants have to balance pasture conversion against the continuity of subsistence agriculture to support their household in years to come. Although outcomes diverge according to specific features of each production unit, peasants are likely to maximize land and labor productivity, and therefore their gain, with the gradual conversion of land to pasture. Even when pastures do not provide immediate economic return to the household (when their financial situation does not allow the prompt purchase of livestock), the yield of annual crops will compensate the investment of labor, thereby meeting most consumption needs. Opportunities to rent or exchange pasture with neighbors is one option that becomes available. Another is to establish formal contracts with established ranchers whose goal is to create an integrated production system. The latter can eventually allow peasant producers to establish their own small herds.

Low and flexible labor requirements

In addition to the optimization of labor allocations during pasture installation, rationality approaches view the expansion of ranching as a favored option due to the relatively low labor requirements. This is particularly important as it frees household labor that can be devoted to other activities. Flexible labor allocation is considered a critical feature of peasant livelihood strategies, and is an underlying principle of the local economy. The fact is that the labor required by ranching operations involves schedules that are compatible with other production activities. The milking of cows occurs only once a day, early in the morning. Because milk is rarely for sale, a small number of cows

are milked, thereby limiting the time needed for the operation. Most are able to finish in time to go to their roças, or to gather babassu. When cattle need to be taken to corrals, this occurs at the end of the day, after workers return from their fields. Overseeing the herd with vaccines and medication is usually done on weekends. Time demanding activities, such as building or repairing fences and weeding pastures, can be done when labor requirements in agriculture are low. According to this perspective, the combination of cattle ranching with babassu extraction and shifting-cultivation lowers the risks involved in household subsistence. Cattle ranching also enhance the use of land and agricultural resources when cattle graze on harvested fields and manure is used to fertilize small orchards and vegetable gardens.

Secure markets for calves, steers, and meat

Cattle is a golden check! You get good payment, and you sell it whenever you want. There is no such a thing as having trouble finding a buyer.

The “golden check” referred to above by a producer in São Manoel illustrates the fact that the market for cattle products is one of the most important drivers leading to the expansion of cattle among resource-users in the Mearim Valley. Indeed, the operation of complex production chains with interrelated functions and parallel trading routes provides multiple economic opportunities to those involved in herding. Small-scale producers engage in the commercial sale of milk in neighboring municipalities (the dairy belt of Pedreiras reaches Igarapé Grande, Bernardo do Mearim, and Lago dos Rodrigues). In Lago do Junco, however, the market is restricted to beef cattle. Small-scale herders are inserted in this chain via two main mechanisms: through the sale of calves or steers to larger cattle-ranchers who specialize in subsequent production phases, and through the direct sale of steers for consumption within local communities. Peasants involved in

small-scale ranching rarely keep their cattle long enough to reach what is considered the optimal weight for sale (250-300 kg of net weight). Under the conditions in which peasants operate, it would take too much time to reach that weight, rendering the operation financially unprofitable. In addition, the monetary needs of the peasant household operate on shorter temporal cycles. Therefore, the alternative is to sell younger cattle (80 to 120 kg of net weight), either to ranchers that operate on a larger scale and take over the subsequent production stages, or to sell directly to local butchers.

Brokers that purchase calves and steers in local communities are key to the survival of peasants that choose the first alternative. These brokers receive a small percentage of the transaction. At least one person plays such a role in most communities, including Pau Santo and São Manoel. Brokers are contracted directly by managers of the larger ranchers in the region, or are subcontracted by middlemen who serve wider areas. The sale takes place once a year, often at the end of the rainy season. The production of beef cattle is favored by the geographic location of Lago do Junco, which is relatively close to and served by roads that connect the region to large slaughter houses located in the urban centers of São Luís, Teresina, and Imperatriz. The demand for good-quality calves, combined with the social insertion of local brokers within their communities, create a commercial bond that is likely to be repeated in subsequent years. In extreme cases, producers that experience financial problems are forced to sell their calves even before they are born (*venda do bezerro no bucho*). Such contracts mimic the more traditional form of commercial exploitation for agricultural products, based on the sale of rice before the harvest has taken place.

The other alternative is the direct sale of steers for consumption at the local market. Contrary to 15 years ago, an increasing number of peasant communities engage in a weekly slaughter of cattle. The slaughter of cattle and sale of meat are done by local residents that assume the role of part-time butchers, usually on weekends. Cattle are purchased in the community or nearby areas, and the seller is paid after 1-2 weeks time. The seller often witnesses the slaughter and weighting of each quarter-part of the steer or heifer. The average weight of cattle sold locally (100-150 kg net) is below that of cattle sold in the city (150-200 kg), and considerably lower than the cattle purchased by large slaughter houses (250 kg). The profit margin for each kilo of meat ranges from 10-20%. Slaughter is done near the village, on sites covered with babassu leaves, under very questionable sanitary conditions. Small facilities are improvised for the sale of meat, which occurs early in the morning. Some butchers purchased a freezer to store unsold parts. In addition to the monetary profit that he might earn, the butcher also retains a certain amount of beef for the consumption of his extended family. The head, and internal organs, such as the liver, heart, stomach, and kidneys are usually sold separately, or given as a payment for those who helped in the slaughtering process. More recently, the market for leather has expanded. The sale of this commodity has assumed greater importance to local butchers, who now receive advanced payments from leather merchants.

The scale of such operations suits the needs of a local community. The weekly slaughter of a 120 kg-steer, for example, provides for the average consumption of beef in a village with 40-50 households (considering a weekly consumption of 2.5 to 3 kg of beef per household). Meat payments by consumers also follow weekly or by-weekly schedules. Although the slaughter of 120 kg-steers in these communities seems to

comprise a very limited market, the scale of these transactions assumes a relevant dimension when all communities in a given municipality are considered. For example, the municipality of Santa Luzia, the largest in the Pindaré Valley, includes some 400 villages and rural settlements. If we assume that one out of four communities promotes a weekly slaughter, the result is an annual sale of more than 5,000 cattle in that municipality alone. The income from the annual sale of this meat (600 tons) corresponds to some R\$1.5 million (US\$ 0.6 million) which circulates entirely at the local level. Although the numbers for Lago do Junco are likely to be one tenth of Santa Luzia's, the amount is still considerable given the small size of the municipality, the lack of alternative sources of revenue, and the additional benefits provided by cattle.

In sum, rational modes of peasant behavior stress the cost/benefit calculations that households perform over the life cycle, in terms of the allocation of land and labor resources. Yet, the search for maximized individual or household utility has to be considered in the context of other factors that condition resource-allocation, such as the fulfillment of social functions, the influence of broader social structures, the expression of cultural values, as well as the opportunities and constraints imposed by the biophysical environment. Although the latter may be perceived as part of concrete conditions that compose scenarios for rational decision-making, I prefer to treat the role of biophysical conditions, or more precisely, the human/environment interactions that lead to the expansion of small-scale ranching, as a separate analytical domain.

Approaches that Emphasize Human/Environment Interactions

The trajectory of land-use/cover in Lago do Junco is itself indicative of adaptive processes through which the characteristics of the biophysical environment within which resource-users operate also condition the economic alternatives that are presented to these

same resource-users. In this particular case, an adaptive process began with the use of forest products, included the clearing of these forests for cultivation of swidden fields, and the subsequent extraction of babassu products in areas of secondary succession. At later stages, the process led to the conversion of secondary growth to pasture grass for cattle herding, maintaining an upper strata of babassu palms in consortium with these pastures. Finally, as seen in Chapter 4, more recent trends encompass the reversal of the latter conversion, and the recovering of lands in secondary growth for annual agriculture. Other land-use alternatives were introduced in the nearly eight decades of Lago do Junco's occupation by peasant producers. However, none of them was as thoroughly disseminated as the combination of the three activities mentioned above. The changing biophysical characteristics of the region and the predominant pattern of secondary succession in the area are factors that contributed to the constitution of an integrated system that did not promote novel and distinct economic strategies, but rather dynamically transformed the ways in which shifting-cultivation, babassu extraction, and cattle ranching are performed.

Ecological processes that occur once the original landscape is altered by human activities subsequently mediate the social processes that alter the attitudes and practices that result in the combination of palms and pastures on landscapes previously devoted to annual cropping. First, fire-tolerance, the endurance of its fruits, and the plant's capacity to regenerate after cutting means that babassu is extraordinarily resilient, showing a great capacity to progressively disseminate into contiguous areas. Moreover, babassu's ecology and population dynamics enable the plant to subsidize the establishment of annual crops and/or pastures. Second, the recycling of nutrients and the consequent soil fertility in

areas under shifting-cultivation are able to maintain reasonable levels of yield returns only when appropriate fallow periods occur. This has not been the case during the last two decades in most of the municipality. Finally, jaraguá grass is particularly adapted to these disturbed environments due to features such as rapid growth, aggressive dispersal by wind, resistance to fire and to seasonal droughts. These biological features contribute to the expansion of pastures, and consequently, to the growth of ranching in areas that are covered with babassu and that no longer provide satisfactory agricultural yields.

Moreover, the combination between jaraguá pastures and babassu increases the likelihood that each component of the ecological system will be successful. The recycling of biomass provided by senescent babassu leaves enhances the time-span of pastures, while the partial shade provided by standing palms helps to retain soil moisture. Conditions provided by pastureland, on the other hand, result in the optimal population distribution for the palm. In addition, greater insulation results in higher biomass production for individual palms, therefore yielding better-quality (larger, heavier) fruits. Jaraguá pastures are not as aggressive as brachiarias, and do not impede the growth of babassu seedlings or the regrowth of juvenile palms. These pastures will allow the recovery of second-growth vegetation, and the reestablishment of shifting-cultivation.

In this way, the land-use options that are available to people at one point in time (the focus of rational models of behavior) are themselves the product of land-use decisions that were executed in the past. Moreover, the connection between past land-use patterns and present day land-use options is heavily mediated by factors that are strictly biological and ecological in nature. In this case, the fire resistance and germination rates of a particular species of palm (babassu) interacts with the adaptive qualities of a

particular species of grass (jaraguá) to produce in human-disturbed environments a new set of biophysical conditions that promote the expansion of pastures, thereby enhancing the economic attractiveness of cattle ranching.

Human intervention in the biophysical environment thus entrains biological and ecological processes that set a new stage for a subsequent round of land-use decisions (which will, in turn, have their own environmental and social consequences that will condition future decisions). It is this dynamic process that is of particular concern to those interested in sustainable production, but which is systematically overlooked by the synchronic character of rational models. While the latter are valuable heuristically at one point in time, they come up short when the object is to understand the prior determinates of present conditions (as well as the present determinant of a future to come). Further complicating this picture are the social and political factors that also play decisive roles in the trajectory of the social and physical landscape.

After more than two decades of struggle and dispute for resources in the Mearim Valley, the resulting distribution of localities and their respective landscapes follow a pattern that is closely related to the distribution of power. Flatter lands that are closer to major roads tend to be controlled by large landowners, most of them ranchers that utilize mechanization and, in most cases, reduce babassu density to minimal levels. In these areas, predominant pasture management strategies include the substitution of brachiarias for jaraguá grasses. On the other hand, areas with rolling topography and that are further from highways are considered less valuable, and therefore tend to remain under the control of peasants and small-scale cattle ranchers. These areas are characterized by denser babassu stands, and most of the existing pastures still are of the jaraguá type.

The discussion in Chapter 4 emphasized the preference of peasant producers for economic strategies that combine annual crops, babassu extraction, and small-scale cattle herding. Narratives of Pau Santo and São Manoel's residents have indicated their dissatisfaction with management practices among ranchers that resulted in the elimination of palms and the replacement of brachiaria for jaraguá grasses. Such dissatisfaction extended to internal land-use developments that, more recently, provoked sub-optimal conditions for babassu extraction after the re-conversion of palm-filled pastures to second-growth. These reactions are coherent with perspectives that treat biophysical configurations as active participants in forming complex socio-natural ensembles. The elimination of babassu stands, and the worsening of conditions for extraction, are both perceived as acts of extirpating part of these resource-users' livelihood. Therefore, as long as part of the land is maintained for annual agriculture, one can consider the integration of cattle ranching in areas covered by babassu palms as strategic to the continuity of such integrated system of production.

Functional and Relational Approaches

Perspectives other than strict economic rationality explain the expansion of small-scale cattle ranching by assuming a fundamentally different view of human nature. In this view the reproduction of the social group, or the reproduction of relations among and within groups are the guiding principles. According to this standpoint, the rationality of engaging in ranching is not restricted to a narrowly defined economic dimension. Particularly in areas of violent conflicts and the eviction of peasants, rational strategies include the ultimate objective of seeking the maintenance of peasant households on their land, as well as their physical reproduction. For those able to invest labor, the subsequent conversion to pasture after annual crops is viewed as the least expensive way to claim

tenure security, or otherwise to obtain financial compensation for the work put into the land. Functional approaches highlight the social roles played by ranching activities, while relational perspectives emphasize the functions of these activities in relation to other sectors of society, and within the constituents of each social group. The application of these perspectives to the case being examined will be presented next.

Products, services, and functions of cattle herding

Labor pooling and the sharing of subsistence products are traditional practices in peasant societies in Maranhão, particularly during their initial stages of land occupation. For example, sharing of game or pork meat among kin and neighbors was often observed when peasant communities were less involved in market transactions. These practices, however, became less frequent once changes in land-use/cover limited the availability of game and constrained the traditional form of raising free-range pigs. To some degree, and under certain conditions, today the products and services provided by cattle herding fulfill equivalent functions. Indeed, herding activities assume a less individualistic nature than annual cropping. Because rice and manioc yields are viewed as critical for household subsistence, they confer a more intimate relationship between resource-users (men and women) and the resource (land being cropped). Cattle raising, in contrast, is still considered a complementary activity by most peasants that engage in ranching. This allows a more collaborative approach to pasture management. Labor requirements of raising cattle, and the scale of operation of individual livestock owners, call for cooperation in tasks that would otherwise be fragmented and less efficient. This is particularly so in areas collectively owned and commonly managed, such as several of the settlement projects in the Mearim, or on private lands where peasant resource-users collaborate to obtain access to credit.

Tasks that require coordination include pasture clearing and management, the building, expansion, or reformation of fences, the construction and maintenance of firebreaks, and herd management. When these tasks are performed collectively, they may reinforce the social organization of the groups involved. In so doing, they constitute an important instance for harmonizing conflicting interests and strengthening social ties. When properly carried out, these activities benefit the group through the periodic distribution of cattle, and the formation of a "savings account" to be reinvested or to pay for other group needs. The latter may consist of basic community infrastructure, a subsidy to less profitable initiatives, and the payment for travel and other costs related to the operation of institutions such as associations, cooperatives, and even the support for local social movements. The steady maintenance of a seed-herd is essential to this strategy. As exemplified by São Manoel settlers, these activities integrate common resource-management with private ownership, and partially transfer management responsibilities from the household to the community.

Peasant ranching can include a great deal of labor exchange within communities, or the exchange of labor for products such as milk, meat, or even calves. Economically constrained households see the opportunity to get milk for their children as an incentive enough for cooperation. Neighboring households frequently assist ranchers that are short of labor. They carry out tasks such as milking cows or taking the herd to the corral at the end of the day, receiving a daily milk supply in return. On other occasions, there is simply a reciprocal exchange between small-scale ranchers who temporarily offer benefits (mostly milk), as their herds do not permanently include a milk cow. A variety of non-monetary transactions also occur among larger production units that hire permanent

laborers. The most common of these transactions is locally called “pagamento por sorte” (payment by luck). In this arrangement, vaqueiros receive a share of the calves born during the year. If pasture is not a limiting factor on the ranch, employees are sometimes allowed to keep their share of cattle grazing on the ranch, free of charge.

The transactions described above are particularly convenient to capitalist ranchers who, as a result, save on labor costs. Payments do not always reflect the amount of work performed. However, such transactions serve to redistribute capital assets, and to convey the knowledge required to raise cattle. In doing so, the exchanges tend to attenuate the effects of economic differentiation. These customs and practices, in addition to being economically rational for both sides involved, evidence a moral system of mutual obligations in which the better-off assist those in need, maintaining social life through functional relationships. The dominant condition of the powerful is reaffirmed through these practices, while subordinate groups gain access to valued benefits. In addition to meeting their livelihood needs, the exchange relationships enhance the social standing of less powerful groups. The situation in Pau Santo shows, however, that this harmonization of interests is possible only to a limited extent. As seen in Chapter 3, a political economic perspective seems especially relevant in communities where land-use and land-cover outcomes are strongly influenced by the competition of powerful interest groups.

Rural stability and fixing populations to the land

Livestock ownership is traditionally viewed as an effective strategy for the reproduction of domestic units of production. When ranching is carried out in fixed sites (as opposed to seasonal grazing areas), ranching and social reproduction are bound together within specific spatial boundaries. When compared to other agricultural undertakings common to the region, cattle ranching not only contribute to the social

reproduction of the household, but also offer the additional appeal of promoting the establishment of roots to a particular piece of land. The ranching activity has therefore the comparative advantage of providing resource-users with greater stability in a given place. The expansion of ranching among peasants in Lago do Junco who experienced land struggles is not detached from such a perspective. Rather, the process corresponds to a reinterpretation of an activity that offers critical values associated with a valued lifestyle. Following the period when ranching was forbidden, in the post-struggle period peasants gradually reincorporated cattle into their livelihood strategies in the search for greater stability. For those who continuously struggled for survival, this image of stability was a departure from the repeated spatial and occupational moves forced upon them by unequal entitlements and power relations. Ranching can thus be considered part of a process by which peasants recovered cultural values that remained hidden during periods of land struggle, or constructed new social roles when the violence subsided. In other words, owning cattle can be an integral part of the process of readjusting and reshaping cultural identities in specific configurations of differentiated peasant societies.

Insurance mechanism

An additional instance through which the social function of livestock is expressed is the use of cattle as an insurance mechanism. Given unfavorable markets for agricultural products and the lack of tangible alternatives for the investment of small amounts of capital, the liquidity provided by the market for cattle products is seen by resource-users as critical in their decision to apply limited savings to purchase a heifer or steer. The insurance character of small-scale livestock assumes an even greater expression with the increase in social security benefits in the last decade. Indeed, the purchase of steers and heifers has been one of the preferred investment options for the

elderly who received retirement benefits in Pau Santo and São Manoel, and in the entire Mearim Valley. Retirement payments have considerably enlarged the participation of cattle within traditional production systems in peasant communities, generating an alternative source of employment and increasing the internal circulation of revenue in these communities. For those who are no longer able to perform agricultural activities or babassu extraction, the option to invest in cattle enables them to remain inserted in the productive process. Therefore, in addition to contributing to the annual household budget and to improved socioeconomic conditions, the regular sale of one or two animals fulfills the important role of insuring against critical financial problems due to crop failure, disease, or unexpected family problems. Moreover, this perspective views cattle ranching as providing economic opportunities that reinforce the internal cohesion of the group. Again, this role is contested by political economic approaches, to be reviewed next.

Intergenerational differentiation

Better education and transportation, and the market developments that followed the period of land struggle in the last decade improved social interactions and economic opportunities, especially for the current generation of youths: the children and grandchildren of the main agents in the transformation of the socio-natural ensembles of Pau Santo and São Manoel. Indeed, an explicit goal is upward social mobility via the establishment of a merchant enterprise and the acquisition of land to raise cattle. Initially, processes of social stratification within peasant communities in rural areas of the Mearim Valley were exclusively based on merchant capital. Subsequently, these processes became intimately involved in channeling resources to cattle ranching. Therefore, although ranching still performs basic social and economic functions for the household, an additional feature that contributes to the drive toward ranching is the perception in

rural Brazil that cattle represent an instrument and symbol of power. The commitment of the younger generation to ranching, and their involvement in transactions and issues related to cattle (as opposed for example to roças and babassu extraction), reflects a host of aspirations that imply a transformation from an economy of seemingly undifferentiated peasants, to an economy associated with a differentiated status based on the ownership of capital goods. Contrary to the older generation, by acquiring capital goods and assets, they not only intend to be viewed as differentiated individuals, but also lay claim to social interactions that transcend the boundaries of the local community.

Alliances and positionality

The expansion of cattle ranching is a strategic move that bolsters peasants' stake in the broader political scenario that was once the exclusive domain of large landholders. Engaging in ranching thus served to establish new alliances and coalitions with sectors hitherto aligned against subsistence agriculture practiced by traditional, long-term peasant populations. The latter have typically been viewed by powerful groups as condemned to poverty and environmental degradation. To counter this threatening prejudice, nothing was more effective than to incorporate cattle--a symbol of power and modernity--into the peasants' livelihood strategies.

Perspectives Based on the Political Economic Effect of Broader Social Structures

Despite the adequacy of previous perspectives, the incorporation of cattle ranching as one of the productive strategies of peasants in Lago do Junco should be understood within broader and still unfinished socioeconomic and political developments that characterize the occupation of the Brazilian Legal Amazon. As with mining and logging, the ranching activity plays a chief role in Amazonian society by establishing a rationale that dictates patterns through which are manifested economic differentiation and

social stratification. The result is intertwined spheres of political and economic interests that contribute to the reproduction of class struggles within society.

As has occurred in other parts of the Amazon, starting in the 1960s, government agencies and programs included ranching as a development trajectory designed primarily for large landholders and agribusiness investing in central and western Maranhão. Despite efforts and resources spent on research, credit, and infrastructure, the overall performance of large-scale ranching enterprises in the region is still controversial. The unproductive and underutilized pastures of large landholdings have severely damaged ecosystem integrity. Paradoxically as it may seem, an unintended consequence of the subsidies and support to large ranching enterprises was the subsequent increase in the adoption of ranching by resource-users with more restricted access to land. Small-scale ranchers benefited from market and infrastructure developments that initially targeted large enterprises. More recently, subsidized credit and other direct incentives were specifically channeled to small-scale ranching.

The intended formation of a stratified society, and consumption market

State policies and market developments ultimately play critical roles in political economic approaches. On the one hand, the relatively low economic differentiation and social stratification among impoverished peasant communities is viewed as an obstacle to market integration and to capitalist development in these areas. According to this perspective, capitalist undertakings benefit from programs targeting the development of stable markets for their products. The modernization of the means and relations of production turns out to be an appealing perspective to peasant producers as well, with their increasing needs and requests for improvements in education, public health, transportation, and others services. However, the expansion of ranching fits into a

political economic logic in which policies that stimulate cattle raising would lead to the formation of a differentiated rural middle-class composed of consumers integrated into the market, becoming users of improved technologies and capital goods. The engagement in the ranching activity, by transforming the results of household labor into a more secure capital asset, thus constitutes a reliable investment option. Yet, once the decision to engage in the activity is taken, the results seem to be progressively associated with social cleavage and exclusion. By taking this path to modernization, some will unconsciously lead others to compromise their livelihood.

In short, political economic approaches highlight the expansion of ranching as an ideology-loaded strategy that provokes further divisions within society and enhances unequal social relations. The allocation of resources and economic attitudes of producers that engage in ranching, even those who apparently are not capitalist producers, are similarly influenced by relations of domination characterizing capitalist social formations in the Mearim Valley. Settlement projects marked by the inefficient delivery of agrarian reform policies are, in this regard, fertile terrain for the manifestation of such relations of domination. As the case of Pau Santo again illustrates, traditional forms of social organization are destabilized along the settlement process, and ranching becomes a strategy to consolidate unbalanced power relations within the community. In contrast to scenarios of social harmony associated with cropping and babassu extraction, relations of production that tend to be observed in expanded ranching operations represent the adherence to the prevailing social order, markedly through incentives for privatization of capital goods that ensue the individualization of benefits. The end result is a continuous process of greater social stratification, which is promoted by and perpetuates capitalism.

Governmental programs, incentives, and constraints

Political economic approaches treat the expansion of peasant ranching as largely associated with the multilevel struggle for economic dominance and political control among heterogeneous segments that compose and influence social configurations at different scales. According to these perspectives, small-scale cattle herding articulates with large-scale ranching, and reaffirms the power and economic interests of those involved in the latter. This is evidenced, for example, when subsidized funds of agrarian reform programs were massively directed to acquire livestock in several settlement areas of the Mearim. Similar to developments of the FNO program (the Constitutional Fund for the North Region) in colonization areas of the Transamazon in Pará (Toni 1999), PROCERA funding has directly benefited large ranchers and dishonest traders that sold lower quality cattle at inflated prices, making sizable profits due to the contracted beef market.³ Although the level of community organization in Lago do Junco attenuated such effects, institutional apparatuses, such as bank and extension service, had repeatedly supported these schemes. By influencing and misleading producers in less organized settlement areas, these institutions led them to purchase livestock under such conditions. The main targets of these schemes were those in charge of making the deals for larger projects. This is confirmed by the quote below, in which a resident of São Manoel describes the treatment given to leaders and directors of associations of producers:

There is a lot of pressure when resources are released. The associations' presidents became kings. The cattle brokers try to do everything to please them. The first thing they do is to lend money, pay their hotel, and so one and so forth.

³ The inclusion of high standard, certified cows is one of the items required by BNB from extension officers that are responsible to elaborate rural credit projects. Projects should include cows producing at least 5 liters of milk/day when fed only with pasture grass (or 10 l/day if receiving supplemental feed). Although these standards seem to be low, they are considerably high for the region. A great deal of deviation is related to the sale of lower standard cows, at the same high price fixed by the bank.

Articulation with capitalist ranchers

Another instance of the multilevel struggle for economic dominance and political control leading to the accumulation of power and resources is the growing trend of partnership arrangements (*sistemas de parceria*) for herding operations. Through these arrangements, large-scale capitalist ranchers consign calves, steers, or cows to medium and small producers that become partially or fully responsible for raising and/or fattening these herds. Two major variations in this process are observed in the Mearim and Pindaré valleys. The first kind is locally called a society (*sociedade*), a partnership for the fattening of steers. Those that provide pasture and cattle management receive steers equivalent to one half of the net weight gained by cattle during that period. The second kind, named the share system (*sistema de meia*) consists of a partnership for raising calves. The participant in the sharing arrangement retains one-half of the calves born and weaned by the end of the rainy season. The remainder is returned to the rancher, who takes over the fattening stage. Although apparently benefiting producers that are able to get a start-up support for their own ranching operations, a careful examination of these partnerships calls attention to the perils involved in the long-run spread of such strategies because they threaten to transform peasant producers into mere supporters of ranching operations controlled by large-scale, market-oriented producers.

Unfair market competition and the political economic aspect of economic rationality

The fall in prices and lack of incentives for cash crops such as rice have stimulated the search for alternative ways to allocate peasant labor and resources. Yet, one has to note that such disincentives were greatly amplified by the competition imposed by producers who adopted modern technology. This is particularly true for rice, the main agricultural product in Maranhão. Rice has been traditionally produced by

peasant units in most of Maranhão, and up to the 1970s the Mearim Valley was one of the main production areas. Since the mid-1980s this peasant-produced rice began to be dislocated from its market niches by greater competition of capital-intensive rice fields installed in the southern region of the state. Subsidized by a program sponsored by state and federal governments (PRODECER, the Programa para o Desenvolvimento dos Cerrados) and counting on support from the Japanese agency for technical cooperation, most of the mechanized and irrigated rice fields in the Balsas region of southern Maranhão are owned and managed by gaúcho farmers recently arrived from Rio Grande do Sul and other parts of southern Brazil. Rice and maize produced using modern technology in this area (as well as in regions as far away as Goiás, São Paulo, and even Rio Grande do Sul) began to successfully compete with local and regional markets that hitherto were supplied with peasant production. Laboring under the additional burden of middlemen in the commercial chains, and as a result of a perverse merchant system, peasants received an even lower price for their agricultural produce. Although such lower prices would hypothetically benefit consumers, the unintended effect was a complete destabilization of peasant production units that once relied on alternative sources of income to supply their needs. Most low-income and land-dispossessed peasants had little choice to adjust their production systems. Those who were able to go beyond subsistence agriculture and who were faced with the opportunity to invest in cattle converted part of their land into pasture.

Approaches Based on Cultural Identity, Social Perceptions, and Symbolic Practices

Individual rationality, functional relationships, and social structure apart, peasants also engage in ranching because of the intrinsic meaning of the activity and the powerful set of values associated with it. In this regard, I see three complementary approaches to

explain the events that are taking place. The first approach considers the assimilation of attitudes and practices peculiar to ranching, and the resonance of these activities with early experiences and cultural understandings. Cattle-related attitudes and practices are part of these people's historical identity, and are backed by tradition and habit. As such they are the basis of custom, emotion and power.

The second approach focuses on mechanisms through which dominant sectors in the Brazilian agrarian society take advantage of these historical affinities. The latter shape the needs and attitudes of peasant producers, promoting a greater desire for goods and a lifestyle that reflects the interests of the dominant sector. The third approach considers the dissolution of the strong ideological dichotomy, that until recently, had associated cattle ranching with anti-agrarian reform, anti-ecological discourses, and political perspectives opposed to land distribution.

Origin and cultural background

My occupation in Ceará was always to deal with cattle...I was born and raised in that kind of thing. My dad was in a position to give me an education, but I did not graduate because of my own wish. I did not like to study. What I really enjoyed at that time was to catch those angry bulls in Ceará's sertão. I liked to do that, I liked the rodeos, those things. To deal with cattle was my occupation in my whole life, so when I got here I sought to do what I knew. Not only me, but the others, too.

As expressed in the above quote by one of the several contemporary Northeastern ranchers in central Maranhão, cultural explanations for the expansion of ranching among peasants suggest the compatibility of ranching with traditional world-views and livelihood systems characteristic of their identity formation before the "ideologization" of ranching. In Chapter 3, I have shown that the cultural background of resource-users in Lago do Junco is heavily influenced by Northeastern heritage. People from the Brazilian northeast have an intimate and long-term relation with livestock herding. Contrary to the

more recent expansion of the activity in most of Maranhão and Amazonian states, Northeastern producers (mainly those from Bahia, Pernambuco, and Ceará, and later those from Piauí) have been exposed to practices and cultural features of ranching for several generations. In their states of origin, acquaintance with ranching took place, either through direct engagement in small-scale operations on resource-restricted grazing areas, or indirectly by working on or simply experiencing the effects of the ranching economy in neighboring production units. Another important Northeastern influence in Lago do Junco (and other parts of the Mearim) was the arrival of pioneer producers of Northeastern descent who, since the mid-19th century, explored grazing lands in southern Maranhão, and engaged in ranching operations in the region of Grajaú. The combined presence of these two groups of resource-users effectively set the stage for a compelling dissemination of the values and virtues associated with ranching.

Influence of mass media and popular culture

In addition to people's own cultural background, local perceptions of ranching are further influenced by dominant economic interests. One can get a sense of these influences by spending time in towns and farms in the countryside, and observing popular culture and mass media. Similar to most places in the Brazilian North and Northeast regions, cultural values are transmitted by important social events in the Mearim Valley that promote and exalt the way of living of ranchers and cowboys. Events such as Boi-Bumbá in Pará and Amazonas, and Bumba-meu-Boi in Maranhão are an important part of folk culture. But today, vaquejadas are the foremost example of cultural events that promote a lifestyle centered on cattle ranching. Not yet recognized as a sport, vaquejada is a rodeo style of competition where skilled horsemen race to lasso young bulls. Some vaquejadas are small events, traditional in style and performed on fazendas.

Others are widely publicized to show-business types that require special facilities in larger cities. The dream of young males in the countryside is to be recognized among the elite of *vaqueiros* (horsemen). Regional circuits of *vaquejadas* run for the entire season, attracting semi-professional bull riders and an audience of thousands. Lago da Pedra and Pedreiras have their *vaquejadas*, while in Bacabal an even more ambitious event takes place, consisting of a regional livestock exposition.

Vaquejadas and expositions are big business for local elites who control advertising and concessions for food, clothing, and other products related to the occasion. The sale of animals and agricultural equipment figure prominently. The events culminate with late night shows by professional bands that consist of entire ensembles using state-of-the-art equipment and choreography. The bands are well paid to perform popular music (*forró*) with lyrics that extol the achievements of ranchers and cowboys. It is via events such as these that the mass media participates in the exploitation of peasants, and serves as a mechanism for shaping peasant preferences and attitudes.

Agrarian symbolism

The role of symbolic culture in peasants' perception of cattle ranching is manifested in the extreme situation of their struggle against ranchers, when they demand the repossession of land. In Pau Santo and São Manoel, where the survival of the peasant group was at stake, the conflict was conceptualized as a confrontation between cattle and pasture on the one side, and *roças* and *babassu* extraction on the other. In the course of the conflict, peasants thus came to see cattle as instruments of oppression and dispossession, and therefore rejected and morally excluded ranching from their production possibilities. Once conflicts were resolved, the re-inclusion of livestock as an economic alternative ran parallel to the reaffirmation of these peasants' tenure security.

In this way we can see that the allocation decisions of peasants were gradually redefined by structural forces and processes that once again endorsed cattle ranching after a hiatus of moral proscription.

Practice theory and the understanding of ranching expansion

Postulates of the theory of practice highlight the dialectical integration of objective practices and the various ways that these practices are perceived by the subjects, and contrasted with the internalized structures that form their habitus. By interpreting how subjects perceive their social world, it is evident that ranching encompasses conditions of an uncontested and unconscious assimilation (doxa), as well as orthodoxy and eventually heterodoxy (Chapter 2, page 90). Evolutionary assumptions are not attached to this formulation. The differences between Pau Santo and São Manoel show that the passage from one condition to another does not occur simultaneously in all situations, nor is each case characterized by the entire sequence of transformations.

Historical and temporal dimensions prove to be particularly relevant to understanding the changes in perceptions and practices associated with small-scale cattle ranching. The structural factors that determined the subjects' conditions of existence resulted in the perception of cattle as "naturally" fulfilling important functions for their livelihood and social reproduction. To this structural-functionalist interpretation, we can add the historically and socially situated material and mental conditions that prevailed in the past, both in Lago do Junco and in the areas of origin of migrant peasants. These mental legacies constituted the habitus that engendered thoughts, perceptions, practices and discourses that viewed cattle as a desirable asset because of their use value. Customary rules and shared interests from these past experiences were gradually

deposited and preserved in the memories of resource-users as a common material and symbolic patrimony. This symbolic patrimony added to people's cultural capital, enabling them to generate responses and adapt to changing situations.

Factors that alter structural conditions are unconsciously incorporated into the habitus. This occurs through a process in which actors, as they generate practical knowledge, continuously decode and incorporate the consequences of their actions, as well as the reactions to these consequences. This continuous readjustment of practices occurs as a self-regulatory device that redefines the course of action in accordance with the effects produced by previous actions on the agents involved (Bourdieu 1977:10-11). Until approximately the late 1960s (the period of economic differentiation as presented in Chapter 3), cattle were not viewed as an instrument of class struggle. The prevailing habitus thus minimized the risk of conflict and contention among and within social groups. The expansion of ranching was, however, limited by infrastructural conditions at the time. Such conditions came into being only when ranching enterprises moved into the region and began to exert their political and economic influences. Therefore, the practical and symbolic experiences that characterized the doxic perception of cattle became the basis for the expression of functional relationships and for the integration of cultural values and beliefs in the latter expansion of cattle ranching.

Increasing socioeconomic differentiation paralleled the establishment of the infrastructural conditions conducive to the expansion of the ranching activity, thereby transforming the subjects' perception of the activity. With increasingly differentiated conditions of existence, the unconscious assimilation expressed in the doxic relation no longer represented a correspondence between subjective principles and the objective

world. When the social world loses its character as a natural phenomenon, the dominated classes push back the limits of doxa, exposing the arbitrariness of that which was taken for granted (Bourdieu 1977:168-169). As the Mearim Valley was increasingly transformed, there was a point when the habitus was no longer common to distinct groups. Socially constituted systems of cognitive and motivating structures represented by the habitus ceased to correspond to the socially structured situation in which the agents' interests were defined (the conditions in which the habitus operates). The questioning of a particular habitus is brought about by conceiving another state of affairs, which in turn is a consequence of political and economic crises associated with class division. This situation characterized the socio-political environment in the region during the 1970s and 1980s (the period of social stratification). In this period, ranching became predominantly perceived under the precepts of orthodoxy: an instrument of economic expansion for the hegemonic class. The discourse and practices centered on cattle, and the expansion of pasture into forested land became associated with social injustice, symbolizing the broader class struggle.

However, peasant producers did not homogeneously experience the constraining effects of this orthodox view of cattle. As Giddens (1984) posits in his "structuration theory," structural properties of power relations both constrain and enable human behavior. Accordingly, peasant adoption of cattle ranching shows how dominant ideological precepts and political circumstances combine within particular trajectories in each peasant community, and are thereby assimilated by individual subjects. This new order enabled the expansion of ranching, initially among individuals and households operating on the basis of a broader concept of rationality. While still constraining those

who associated ranching with the disruption of their social system, the overall result was the expansion of the activity, setting the material conditions for widespread growth of ranching in the 1990s. In short, cattle ranching of the 1970s and 1980s in Lago do Junco was perceived under the condition of orthodoxy. Under such a condition, it was a fertile terrain for the manifestation of self-interested rationality and for the enhancement of political economic contradictions perpetuating capitalism.

In the 1990s, however, social injustices and arbitrariness associated with ranching became increasingly disentangled from the activity itself. Reduced (although sometimes only less visible) social and moral transgressions and extended material accessibility allowed a growing number of peasant producers to accept ranching as a viable option. Under circumstances that both individual and group benefits were increased by engaging in the activity, the basis for decision-making and practical action towards ranching is informed by a broader set of factors presented throughout this discussion. Although inherited from the conditions described above as doxa and orthodoxy, these factors are continuously adjusted by the cumulative perception of new occurrences. To state, however, that a better-informed perspective on cattle ranching is sufficient for the recognition of heterodox courses of action would be inaccurate in the vast majority of cases. Ranching was adopted by peasants because of a combination of forces: it maximizes utility, it is compatible with the conditions of the local environment, it assists in the maintenance of social life, and is compatible with cultural values and beliefs. By raising cattle, peasants appear to rationally operate with constraining and enabling structural forces. Yet, one cannot underestimate the effectiveness of society's dominant sectors in using even broader mechanisms to embed their interests in advantageous

relations of production, consumption, and power. The problem here is the illusion of freedom of choice, when, in reality, actors face a limited menu of options. Given such limitations, expanding their engagement in ranching was, as Bourdieu would say, a “practical answer to the practically, historically situated problems which were forced on them in a determinate state of their instruments of material and symbolic appropriation of the world.” (Bourdieu 1977:115). Although a number of emergent situations seem to point in that direction, a true condition of heterodoxy in regard to the economic behavior of peasants in Lago do Junco--and in the entire Amazon--will not occur as long as the current structure of inequality and power is preserved.

Conclusion

Cattle ranching is becoming a ubiquitous component of ecosystems in the Amazon, resulting in profound social and natural consequences. To examine the expansion of cattle ranching among peasants in Lago do Junco, in this chapter, I have used the analytical framework of a “grounded political ecology,” which is based on elements of practice theory and the ecology of practice. The discussion combined five complementary perspectives for the analysis of complex socio-natural ensembles that dynamically transform (and are transformed by) the expansion of ranching. Throughout the previous sections, I argued that no single approach can fully explain the outcome.

Indeed, even in a geographically limited range such as the one studied here, we can encounter socio-natural ensembles ranging from conditions in which the ranching activity is naturally and unconsciously assimilated into the livelihood of peasant producers, to others in which power and class interests impose the activity as an instrument to enhance the power and privileges of hegemonic sectors, increasing social stratification and perpetuating capitalism. Conditions in São Manoel reflect a new order

of things in which social and moral transgressions are gradually disentangled from the activity itself, ranching being part of revised survival strategies produced through collaborative processes of social organization. In Pau Santo, the formation of pasture and the investment in ranching are predominantly carried out by those seeking greater individual utility through the privatization of common resources. Engaging in ranching does not exclude annual agriculture, and land for annual agriculture is still perceived as a common good, unconstrained by fences or physical boundaries. Therefore, while a few individuals appropriate the benefits of cattle ranching in Pau Santo, the negative effects of this decision are borne by the larger group.

The combination of processes mentioned here (and others that certainly exist) will determine the extent to which, and the form through which, ranching will be adopted in peasant communities. When applied to concrete cases such as the one presented here, theoretical formulations that comprise this framework help unravel the predominant processes at work. Accurate assessments of how the five dimensions presented here are combined in each circumstance, as well as the order of causality that operates in these combinations, will better inform socioeconomic analyses of practices associated with ranching (and with other economic activities, as this investigation can be extrapolated to other economic domains) and their interplay with biophysical processes.

CHAPTER 9 CONCLUSION

At the outset of this dissertation, I highlighted three issues with respect to the social and natural processes taking place in Lago do Junco, Brazil. The three topics concerned the production systems that are likely to be adopted in the future by peasants in order to maintain their livelihoods as resources become increasingly scarce; the changes in the level of economic inequality within local communities; and the validity of a dichotomous representation of social systems featuring peasants and ranchers.

The approach I used to address these issues included a comparative examination of two communities, Pau Santo and São Manoel. The comparative method focused on changes over time in the way that households made use of land and other resources. The study focused on understanding the social roots and the environmental implications of specific combinations and shifts in the investments people made in agriculture, ranching and extractive activities. Explanations for the differences between the two communities encompassed a complex set of interrelated factors that operated at multiple analytical scales to influence the resource-use decisions made by rural households.

The analysis documented the details that distinguished the environmental and the social histories of each community. These specificities were interpreted within a broader conceptualization of the relationship between social organization and the natural environment. In order to carry out this examination, my goal was to incorporate innovative theoretical and methodological approaches that potentially serve to advance a multidisciplinary research agenda. The research design used an ethnographic approach to

delineate the historical changes in the livelihood strategies adopted by the two communities. These findings were complemented by data generated by survey and remote sensing techniques to identify quantifiable indicators of changes in resource-use decisions. By mutually reinforcing each other, qualitative and quantitative methods together provided greater strength to the discussion and conferred greater validity to the findings. In addition, this research strategy serves as a reference for further investigations that combine cultural anthropology and studies of environmental change.

Before summarizing the main findings of this study, it is important to note that the year-long process of reflecting and writing about the situation in Lago do Junco was profoundly informed by my own previous experiences in the region. In the course of many years of involvement with the two communities, I have played a number of roles that placed me in direct contact with the subjects under investigation. My relationship to the communities thus implied an unambiguous political stake in the outcome of the events that I both witnessed and took part in. At the same time, these very relationships and commitments contributed significantly to the process of carrying out an objective analysis of events in the region. Among other things, the fact that I was a known and trusted individual gave me access to information and permitted the critical expression of opinions that would have otherwise caused disquiet and suspicion among the respondents. In the end I believe that I was able to benefit from my stance as both an insider and outsider to the research site in order to provide a thorough and objective analysis of the dynamic process of social and environmental change that took place in this region of Brazil.

The purpose of this conclusion is to make explicit the applied importance of the findings. In particular, I address the contributions that events in Lago do Junco are likely to pose for socioeconomic development in the future, as well as the policy implications of socio-natural trajectories of communities located in consolidated frontier areas. The following section summarizes the main findings of this research. I subsequently indicate those observations that, in my view, are potentially relevant to future development policies that target the “babassu zone.”

Synthesis of Major Findings

- The changing profile of land-use, and the environmental implications in terms of land-cover in Lago do Junco, were closely tied to the forms of access to resources, property rights, and power relations that prevailed in the region. The fact that 40-50 individuals own half of the land in the municipality profoundly affected socio-natural trajectories and political-economic transformations within the region over the last half-century. Centered on the struggle for access to land and resources, socioeconomic processes in Lago do Junco brought about important changes in both the social and the natural systems, and in the complex socio-natural ensembles that define the relationship between the two.
- Informed by cumulative events in the past, in the mid-1980s an active social movement in Lago do Junco prompted a sequence of land conflicts that resulted in a significant recovery of land by peasants. The outcome of this process was the formation of a category of “settlers,” the beneficiaries of agrarian-reform initiatives, who struggled to find a viable system of survival under changing environmental conditions. Pau Santo and São Manoel are examples of these initiatives.

- In general, recent transformations in the structure and dynamics of the socio-natural ensembles of Lago do Junco included, in the socioeconomic sphere, the passage from a situation of dichotomy and polarization between peasants and ranchers, to another marked by a spectrum of greatly differentiated resource-users, with significant differences internal to communities following land tenure recovery. Among these differences is the existence of a more diverse profile of land-use alternatives.
- The predominant trend during the 1980s in the Mearim Valley was the increasing transformation of jaraguá pastures (associated with babassu palms) into open *brachiaria* grasslands. In settlement areas, however, transformations in the biophysical sphere included, on the one hand, the partial re-conversion of pastures to second-growth vegetation with the objective of using these lands for shifting-cultivation. On the other hand, the availability of jaraguá pastures within settlement lands influenced a significant expansion of cattle herding among peasant producers in the area. In addition, it changed the characteristics of babassu extraction.
- Land struggles that took place in Lago do Junco illustrate that, once accessibility is not constrained and palm fruit gatherers have the option to extract within areas of regrowth, they are more likely to prefer extracting babassu within these pastures. In Pau Santo and São Manoel, almost 94% of those engaged in babassu extraction indicated their preference for gathering fruits within pastures.
- Long-term optimal conditions for babassu extraction, and the maintenance of socially resilient landscapes in the "babassu zone," however, require a management practice that has not been followed in either community: the systematic establishment of new

babassu plants to replace senescent palms. Without such a strategy, the long-term achievement of socioeconomic needs of peasant communities is in danger.

- Despite these general similarities, contrasting socio-natural trajectories took place in São Manoel and Pau Santo. In São Manoel, social relations and the operation of local institutions enhanced livelihoods and improved welfare. Post-conflict episodes in Pau Santo, however, accelerated internal disparities and precluded the proper planning and management of social and economic initiatives. Although a snapshot taken in the present may indicate that the local environment presents greater integrity in Pau Santo, a more sustainable path appears to be followed in São Manoel.
- Shifting-cultivation remains the backbone of livelihood systems in Pau Santo, where more land is available to peasants. However, the lack of land-use planning in the community has undermined the long-term continuity of forested resources, and precluded babassu stands from achieving optimal productive potential.
- In São Manoel, conditions of relative scarcity of land resulted in the integration of other activities into local livelihoods. Land-use planning in the community included the definition of contiguous areas for cropping and limitations in the size of annual fields. In addition, planning included the maintenance and use of pastures for common herding. The latter also secured the role of babassu extraction as an important source of income in the community.
- Statistical analysis of a socioeconomic survey applied to 226 households in Pau Santo and São Manoel confirmed the ethnographic conclusions. The examination of household income composition showed that cropping on roças remained the main objective in Pau Santo, whereas the integration of cattle ranching and babassu

extraction with annual crops was greater in São Manoel. On the average, Pau Santo residents produced 64% more rice than those in São Manoel, and cropped on fields 50% greater. Conversely, households in São Manoel produced 58% more babassu kernels than those in Pau Santo, while the average cattle herd of households in the former community (11.1) was significantly larger than in the latter (4.1).

- The examination of gini-coefficients shows that income and assets are more concentrated in São Manoel. However, socioeconomic assessments indicate that higher levels of wealth and well-being are present in São Manoel, demonstrating improved standards of living. Indeed, the examination of the lower tails in the distribution of income and assets for São Manoel are significantly higher than the lower tails in Pau Santo, thus reducing the negative effects of concentration.
- Remote sensing techniques also supported ethnographic findings. The remote sensing analysis has shown that, by the mid-1980s, 70% of the land in Pau Santo and São Manoel was converted into pastures, mostly in association with babassu palms. Forest cover was limited to 10-12% of the area, while secondary growth represented 17-20%. In the next 15 years, while São Manoel residents maintained pastures, in Pau Santo, the amount of land potentially available for cropping (forests and second-growth) increased from 30% to 51% of the total.
- The alternative to annual crops turned out to prevail in Pau Santo due to the barriers imposed by internal discord, and turmoil in the community's social relations. The discrepancies in land-use trajectories and social life can be traced to the attitudes, and the agency of residents in the two communities as they confronted socio-structural and ecological opportunities and constraints in the past.

- Greater internal cohesion in São Manoel was in part due to the community's larger and more consolidated kinship and social networks. This condition was, in turn, the result of the histories of social positioning that characterized critical moments in the history of the communities. Of particular importance were Pau Santo's greater social hierarchy and centralization during the initial period of land occupation, and the permanence of São Manoel's residents during the time in which land was privatized and social disparities were more pronounced. Comparing the life histories of residents of São Manoel and Pau Santo at the time of land struggle, while the former constituted a free peasantry, the latter occupied a rather subordinated condition.
- The expansion of cattle ranching among peasants in Lago do Junco has been one of the most critical changes in local socio-natural ensembles. The examination of processes related to such expansion through the analytical framework of a grounded political ecology has shown that differential land- and resource-use allocations are shaped by the extent to which individuals, households, and communities respond to symbolic and ideological factors that are intertwined with power and political structures, and with more tangible economic and ecological determinants for their attitudes and practices toward the natural environment.

Policy Implications and Recommendations

Socio-natural transformations have followed different trajectories in Lago do Junco. The examples of Pau Santo and São Manoel express this variation, and incorporate a strong institutional component shaping these trajectories, represented by the integrated effect of processes occurring at the level of local communities. The careful examination of the political-ecological trajectories and socio-natural transformations in

these communities serves to inform future policies and initiatives in areas of consolidated occupation in the Amazon. Considerations expressed here follow the three questions posed in the beginning of this study.

First, with respect to the technological system and the development of other production strategies, there is a virtual absence of alternatives developed so far in the region. Most local resource-users are still limited to the range of economic alternatives comprised by traditional forms of shifting-cultivation, babassu extraction, and cattle ranching. Low-income resource-users who improved their socioeconomic conditions were inclined to add small-scale cattle herding to their systems of production.

As long as subsistence needs were secured (meaning the availability of land for cropping rice for local consumption), investment in cattle ranching did not conflict with other peasant livelihood components. To the contrary, the maintenance of pastures in association with palms has proven to be viable in economic and ecological terms, and resulted in considerable benefits compared to areas where only shifting-cultivation prevailed. Specific socio-natural conditions of the Mearim Valley contributed to such an outcome, including the presence of babassu palms and its compatibility with jaraguá pastures; the general pattern of residence in villages; and collective practices to access and use natural resources. Therefore, in contrast to perceptions and discourses that unilaterally condemn the spread of pastures, it is recommended that, once land tenure is returned to peasant producers, part of these areas should be kept under palm/pasture associations. Residents of these communities master the labor and management practices needed for small-scale cattle ranching. What is most often lacking is the investment capital to acquire cattle and purchase basic infrastructure. If adequate incentives are

offered in the form of credit or subsidies for collective or individual seed-herds, the maintenance of common pastures can constitute an important means to ensure a relatively short-term strengthening of the financial situation of peasant households.

In a context of scarce resources, the re-incorporation of land for shifting-cultivation, when carried out without a carefully planned land-use strategy, has only short-lived economic results. In addition, it is prejudicial to babassu extraction. As seen in the case of Pau Santo, an unintended consequence of the "post-pasture" process has been the generation of harsher conditions for the performance of extraction, thereby affecting the economic balance within households, with negative consequences at the community and regional levels. Agriculture is still critically important to peasant survival, and there is little indication of a technological package that is able to effectively replace slash-and-burn, shifting-cultivation. Given these limitations, and considering a four-year fallow period, the stock of land that is needed for subsistence agriculture should be in the range of 4-6 hectares/household. This would give each domestic unit the 1-1.5 hectares for planting annual crops. If additional measures are adopted (as mentioned below), fields of this size will be sufficient for the attainment of local consumption needs.

Second, the processes related to economic differentiation and social stratification in Pau Santo and São Manoel have shown that the achievement of improved welfare and better livelihood conditions (in São Manoel) has occurred at the cost of more pronounced inequalities within the community. These inequalities, however, are reduced when compared to the conditions of ranchers outside the community. The violence, and the extreme ideologization that marked processes of differentiation of the 1960s and 1970s should be avoided. However, it would be disingenuous to assume that peasant groups are

homogeneous by virtue. Although peasant societies incorporate reciprocity and redistribution as important internal mechanisms, they have also been marked by wealth and power differentials. In the Mearim Valley, these groups became more homogeneous during periods of struggle. However, such condition was a consequence of the forced dispossession that they experienced since land privatization in the 1960s.

What is possible to grasp from these findings is that peasant communities in Maranhão are likely to include individuals and households who--for various reasons--are more inclined to channel their labor and resources toward the direct improvement in their economic condition. While these individuals should not be deterred in their goals, there should exist mechanisms to attenuate the marginalization of impoverished families. In certain cases, these mechanisms are generated within the community itself, as the case of São Manoel indicates. However, when conditions within the community impede internal cohesion and aggravate discord, social policies should be created by local governments to avoid irreconcilable disputes.

Initiatives targeting small-scale cattle ranching are likely to benefit families that experience better economic conditions. They do not exclude, however, the simultaneous implementation of programs in support of those in the worst economic situation in the communities. Given palm/pasture ecological compatibility, and the consensus over free access to babassu stands that was established in the region, the maintenance of pastures in lands within and around communities will also favor the continuation of babassu as a critical component in the livelihood of impoverished families. If the example of Lago do Junco Agroextractive Cooperative (COPPALJ) is replicated, better prices offered for

babassu products, and small margins of profit for middlemen can have a direct and immediate effect on poverty alleviation.

Cooperative initiatives, however, are likely to fail if not proposed and governed by those who are the ones to benefit by cooperative action. The dissemination of the decade-long benefits that COPPALJ has brought to its more than 100 members is perhaps the first step in this respect. It should be followed, however, by consistent work in social mobilization, and the education of new agents to be involved in the process of cooperative expansion.

Indeed, initiatives of Lago do Junco peasants in the last decade have gradually formed a long-term strategy for sustainable regional development in the Mearim Valley. Conditions today show that, although power relations and distinct ideological orientations are still evident in the field, a less polarized and more diverse society inhabits the "babassu zone." The conditions are set, therefore, for the gradual implementation of broader policies that should involve various societal segments and act on diverse fronts with the objective of effectively reinstating the majority of the rural population as agents of their own livelihood security. This will require continuing efforts at the local level, but also the commitment of governmental initiatives to attenuate inequalities. In line with the preferred economic treatment given to other extractivists in the Amazon, the social and ecological characteristics of the "babassu region" justify special policies targeting the extraction, processing, and trading of babassu products in regional, national, and international markets.

The achievement of a social pact in rural Maranhão may still sound like a utopian dream. The challenges posed by developments like the ones documented in Pau Santo

suggest that difficulties can be anticipated, and that surprises are likely. Yet, peasant initiatives in Lago do Junco show that people are eager for the construction of renewed ensembles that are socially and ecologically resilient. If we compare today's situation with the confrontations of two decades ago, we realize that substantial transformations have taken place, even in the broader political realm. With greater commitment and imagination on the part of the various actors involved, the integration of palms, pastures, and swidden fields observed in the Mearim Valley may point to the kind of socio-natural transformations that can benefit people at the local level and society at large.

APPENDIX A SAMPLE OF SURVEY QUESTIONNAIRE

PESQUISA: USO COMUM DE RECURSOS, DIFERENCIAÇÃO ECONOMICA E MUDANÇAS NA
COBERTURA FLORESTAL

Responsável: Roberto Porro (Departamento de Antropologia / Universidade da Flórida)

Data: _____ Questionário # _____ Município: _____ Localidade: _____

I - IDENTIFICAÇÃO DO PRODUTOR / DADOS DEMOGRÁFICOS

	HOMEM	MULHER
1. Nome		
2. Idade		
3. Município/Estado onde nasceu	m: _____ e: _____	
4. Há quantos anos mora neste local		
5. Escolaridade: estudou até que série		

6. Estado civil: () solteiro () casado () amigado () separado/divorciado () viúvo

7. Há quantos anos o casal vive junto? _____

8. Quantas pessoas moram na sua casa? _____ Quantos adultos? _____ Quantas crianças? _____

9. Das pessoas que moram em sua casa, quantas trabalham? _____

10. Total de filhos do casal: _____ Quantos filhos moram em casa? _____ Quantos moram fora de casa? _____

11. Algum filho faleceu quando criança? () sim () não. Quantos faleceram? _____ Quantas percas? _____

12. Número de partos: _____ normais _____ cesariana _____

13. Mulher fez ligação? não () sim () Com que idade? _____

14 - Pessoas que vivem na casa (além do casal acima citado)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Idade															
Sexo															
Parentesco															
Escolaridade															

Parentesco: (f = filho/a) (n = neto/a) (s = sobrinho/a) (p = pai/mãe) (a = avô/avó) (af = afilhado)
(op = outro parente) (E = empregado) (Ou = outro)

II - INFORMAÇÕES SOBRE O ESTABELECIMENTO (PROPRIEDADE, LOTE, OU POSSE)

15. Possui terra própria? () sim () não

16. Qual o tamanho desta propriedade? _____ ha

17. Desde que ano voce explora este estabelecimento (esta terra)? _____

18. De que maneira chegou a esta terra:

() comprou de terceiros () obteve o lote do governo () aposamento / ocupação

() nasceu aqui / heranca () outro (explique): _____

19. Qual o tipo de documento desta terra? () título definitivo () título provisório () sem documento

20. Faz parte de alguma associação de produtores? () não () sim. Qual? _____

III - DADOS DOBRE O USO DA TERRA

21. Qual o uso atual desta terra

Área atual com pastagem: _____ ha
 Área atual com cultivos perenes: _____ ha
 Área atual com cultivos anuais: _____ ha
 Área atual com capoeira fina: _____ ha
 Área atual com capoeira média: _____ ha
 Área atual com capoeira grossa: _____ ha
 Área atual com mata: _____ ha
 Outra (_____) _____ ha

22. Planos para o futuro (objetivo que gostaria de alcançar):

Pastagem: _____ ha
 Cultivos perenes: _____ ha
 Cultivos anuais: _____ ha
 Capoeira fina: _____ ha
 Capoeira média: _____ ha
 Capoeira grossa: _____ ha
 Mata: _____ ha
 Outro: _____ ha

23. Tamanho do quintal / sítio: _____ x _____ m

24. Área média cultivada por ano com culturas anuais: _____ ha

25. A lavoura (roça) do último ano (00/01) foi cultivada em que tipo de terra?

() mata () capoeira grossa () capoeira fina () palhada () baixão () outro: _____

26. Por quantos anos esta terra estava "descansando"? _____ anos

27. E a lavoura anterior (99/00) foi cultivada em que tipo de terra?

() mata () capoeira grossa () capoeira fina () palhada () baixão () outro: _____

28. Por quantos anos aquela terra estava "descansando"? _____ anos

29. Usou adubo químico? () sim () não

30. Usou adubo orgânico? () sim () não

31. Usou inseticida? () sim () não

32. Usou herbicida? () sim () não

33. Usou trator no preparo do solo? () sim () não

34. Em que mês queimou a roça? _____

IV - INFORMAÇÕES SOBRE PRODUÇÃO AGRÍCOLA / CULTURAS ANUAIS

35. Qual foi seu principal cultivo anual no plantio do último ano (2000/2001): _____

36. Por favor informe abaixo quais foram as culturas plantadas no último ano (2000/2001):

Culturas	Variedade	Cultivos existentes			Área cultivada 99/00 (ha)	Produção colhida	Quantidade vendida	Valor unit.	Valor total
		Rocha 1	Rocha 2	Rocha 3					
Arroz						Kg	Kg	R\$	R\$
Milho						Kg	Kg	R\$	R\$
Mandioca						Kg	Kg	R\$	R\$
Feijão						Kg	Kg	R\$	R\$
Fava						Kg	Kg	R\$	R\$
Outro						Kg	Kg	R\$	R\$

37. Atualmente possui quantas linhas de mandioca: (_____ linhas) em produção (_____ linhas) novo

38. Quantas cargas de mandioca já arrancou desta roça? _____ Quantas cargas ainda espera arrancar? _____

39. Além da roça, plantou feijão no final das chuvas? () sim () não. Quantas linhas? _____

40. Possui algum outro plantio? De que? _____

V - INFORMAÇÕES SOBRE A ATIVIDADE PECUÁRIA E MANEJO DE PASTAGENS

() tem gado e pasto () tem gado, não tem pasto () tem pasto, não tem gado

41. Cria gado? () sim () não. Em que ano começou a criar gado? _____
 42. Quantos animais comprou nos últimos 3 anos? 2000: _____ 1999: _____ 1998: _____
 43. Quantos animais vendeu nos últimos 3 anos? 2000: _____ 1999: _____ 1998: _____

44. Rebanho atual (composição)	touro + 3 anos	vacas		novilhas 1 - 3 anos	garrotes 1 - 3 anos	bezerros < 1 ano	total
		dando leite	outras				
número de animais							
Gado vendido em 2000							
valor recebido R\$							
Gado comprado em 2000							
valor pago R\$							

45. Qual é a origem de seu rebanho?
 () recebeu dos pais () comprou de pequeno produtor
 () contrato de meia com fazendeiro () negociado com intermediário
 () recebeu de meia de outro produtor () negociado em exposição
 () comprou de fazenda () outro: _____
46. Possui pastagem própria? () sim () não. Área total de pastagens (atual): _____ ha
47. A pastagem desta terra é utilizada para:
 () gado próprio () gado de fora/meia () arrendado/alugado () cortesia () outro: _____
48. Valor total cobrado por aluguel de pasto no último ano: _____
49. Valor total pago em aluguel de pasto no último ano: _____
50. Ano que começou a plantar capim: _____
51. Tipos de capim presentes:
 () jaraguá (lageado) () colônia () canarana
 () braquiária () quicúio () outro: _____
 () braquiário () andropogon () pasto natural
52. Na sua opinião qual é o melhor tipo de capim para esta terra? _____
53. Área de pasto formada nos últimos três anos: _____ ha. Tipo(s) de capim: _____
54. Qual a extensão de cercas nesta terra? _____ m
55. Quantos piquetes (subdivisões do pasto)? _____ Qual o tamanho médio dos piquetes? _____ ha
56. De quantos em quantos meses costuma roçar o pasto? _____
57. No último ano o pasto foi roçado? () todo () + da metade () metade () menos da metade () não
58. Quantas vezes o pasto foi roçado no último ano? _____ Em que meses? _____
59. Em que meses do ano foi utilizado fogo para recuperar a pastagem? _____ () não usou
60. No último ano, utilizou alguma destas técnicas para o manejo de suas pastagens:
 () adubo químico () adubo orgânico () herbicida () trator
61. Tipo de mão-de-obra utilizada para roço dos pastos no último ano:
 () familiar () empreita () diarista () empregado permanente () outro: _____
62. Quantas diárias de serviço foram utilizadas? _____ Quantas diárias de serviço foram pagas? _____
63. Qual foi o valor total gasto com roço de pasto no último ano? R\$ _____
64. Quais dos seguintes produtos fornece para o gado?
 () sal comum () sal mineral () capineira () ração () vermífugo
65. Que tipo de vacinas aplicou no último ano? _____
66. Cura umbigo de bezerros? () sim () não
67. Tem problemas com aguadas no período seco? () sim () não
68. Quantas vacas foram ordenhadas no último ano? _____
69. Foi vendido leite no último ano? () sim () não

VI - DADOS SOBRE CRIAÇÕES, PLANTIOS, INSTALAÇÕES E BENS

71. Preencha a tabela com os dados de suas criações:

tipo de criação	cavalo / égua	burro / mula	jumento	Porcos		Galinhas		Outras aves	
				Rep.	cria	Rep.	cria	Rep.	cria
Cabeças em 6.2001									
Vendas em 2000									
Valor recebido									
Compras em 2000									
Valor recebido									

72. Alguma destas fruteiras está plantada e produzindo em seu estabelecimento? Quantas plantas?

banana (covas)	acerola	lima	jaca	ata
mamão	laranja	caju	carambola	graviola
maracujá	limão	manga	cupuaçu	goiaba
abacaxi	tanja	abacate	côco	Outras:

73. Indique se possui algum dos seguintes objetos ou bens?

carro	TV p&b	poço empadrado	caminhão
motocicleta	aparelho d som	água encanada	curral
TV a cores	bicicleta	gerador	brete ou tronco
parabólica	rádio portatil	casa de farinha	cochos cobertos
geladeira	relógio de parede	galpão/ armazém	forrageira
fogão a gás	filtro	moto-serra	balança grande
máq. de costura	fossa ou latrina	trator	casa na cidade

74. Indique as condições de sua moradia:

dimensões:	cômodos:	parede	telhado	piso	energia	alpendre	canteiro
x metros	_____	Pa Ba Ma Ti	Pa Ma Te	Ba Ci Ma	elétrica () sim () não	() sim () não	() sim () não

VII - DADOS SOBRE CONSUMO E COMERCIALIZAÇÃO:

75. Quais os cinco produtos para a alimentação da família que se tornam os maiores gastos em sua casa?

() () () () ()

76. Quais os três produtos não alimentares que representam os maiores gastos em sua casa?

() () ()

77. Qual o consumo mensal em sua casa de	
arroz	kg
feijão	kg
farinha	kg
açúcar	kg
café	kg
óleo	l
sabão	kg
querosene	l

78. Consumiram em sua casa na última semana:	S N	C=compra P= produz G= ganha	quantidade consumida na semana
leite			
ovos			
peixe			
carne de gado			
carne de porco			
carne de frango			
carne de caça			

79. Quanto gastou no mês de _____ com:	
alimentação	
transporte	
saúde	
educação	
roupas	
moradia	
objetos/bens	
diversão	

VIII - DADOS SOBRE AS FONTES DE RENDA DA FAMÍLIA

80. Quais as fontes de renda que contribuíram para a manutenção de sua casa no ano passado?

a) venda de produtos agrícolas, extrativos e da pecuária								
	qtdd	valor		qtdd	valor		qtdd	valor
Arroz			Gado			babaçu (coco)		
Farinha			Cavalo, burro			carvão		
Tapioca			Jumento			Oleo, azeite		
Feijão			Suínos			Palhas		
Milho			Galinhas			Outros prod. babaçu		
Fava			outros animais			Madeira		
Melancia						Peixe		
Banana			Leite			Artesanato		
Outras frutas			Queijo					
Outros prod. agrícolas			Ovos					

b) Trabalho assalariado ou pagamentos do estado			c) Outros tipos de receitas		
	qtdd	valor		qtdd	valor
Diárias em trabalho na roça			Comércio		
Diárias trabalhando na juqueira			Garimpo		
Diárias na cidade			Remessa de parente		
Salário mensal em propriedade			Aluguel de solta		
Salário mensal em trabalho na cidade			Cobrança de renda		
Salário mensal do município ou estado					
Pagamento de serviços (profissão: pedreiro, carpinteiro)			Outras:		
Aposentadoria ou pensão					

IX - DADOS SOBRE A ATIVIDADE EXTRATIVA

81. Alguém em sua casa trabalha na coleta e quebra do babaçu? () sim () não
82. Quantas pessoas trabalham no babaçu? ____ pessoas. Quantos adultos? ____ Quantas crianças? ____
83. Em que meses do ano trabalham mais na quebra do babaçu? _____
84. Em que meses do ano trabalham menos na quebra do babaçu? _____
85. Quantos quilos de amêndoas vocês venderam na última semana? ____ E no último mês? ____
86. Qual você estima ter sido a produção de amêndoas vendidas por sua família no ano passado? ____
87. Vendem as amêndoas: () diariamente () 2 vezes por semana () uma vez por semana () outro
88. Aonde vendem o babaçu: () na cidade () no próprio povoado () em outro povoado () caminho
89. Aonde estão coletando o babaçu? () mato () capoeira () roça () solta
90. Em que tipo de terreno preferem coletar o babaçu? () mato () capoeira () roça () solta
91. Que distância máxima caminham para coletar o côco? ____ km. Em média, qual é a distância? ____ km
92. Estão utilizando animal para a coleta? () sim () não.
93. Quem coleta e toca o animal? () esposa () marido () filho () filha () outro: ____
94. Em que local estão quebrando as amêndoas? () em casa () no mato () na solta
95. Aonde preferem quebrar? () em casa () no mato () na solta
96. Fazem carvão de babaçu? () sim () não
97. Quem da família trabalha fazendo carvão? () esposa () marido () filho () filha () outro: ____
98. Em que meses do ano faz carvão? _____
99. Quantas vezes por mês? _____
100. Qual a quantidade média de carvão produzida por mês? ____ latas
101. Vendem carvão? () sim () não

APPENDIX B

REPRESENTATIONAL AND IDENTIFICATION CATEGORIES APPLIED TO RURAL PEOPLE IN THE MEARIM VALLEY

In Brazil, a number of situational terms designate rural people given specific contexts of their historical moment. This applies to categories denoting specific land tenure arrangements, the most common term being *proprietário* (owner, or landowner). Landowners are roughly classified according to the size of their landholdings as *pequenos* (small), *médios* (mid-size), or *grandes* (large). The Brazilian agricultural censuses classify rural landholdings (*estabelecimentos rurais*) according to whether they are run by: *proprietários* (landowners), *posseiros* (squatters), long-term residents with no legal title, and two types of tenants: *arrendatários* (renters), who pay cash to use someone else's land, or *parceiros* (sharecroppers), who use a fixed or variable portion of their yields for that purpose. The Portuguese usage does not include a direct correspondent to landholder (and derivatives such as *smallholder*), an analytical category that is detached from the strict notion of property.

Another group of representational categories are terms applied to specific relationships with state programs or policy mechanisms. This is the case of designations such as *colonos* (colonists, who receive or buy land, usually from the state through a colonization scheme, in frontier areas), *assentados* (settlers, benefited by settlement projects in lands purchased or expropriated by the state), *sem-terra* (landless people, who lost their original condition of landholder), and *ocupantes* (occupants, organized landless

families that claim tenure rights over state or private property). Still other categories are those related to occupational functions, such as gerentes (managers) and peões (manual workers) in ranches, or other designations (mostly absent in the study area) such as suinocultor, avicultor, piscicultor, apicultor, respectively referring to those who raise pig, poultry, fish, and honey bees.

Switching focus to the identificational terms, cultivator, producer, and rural worker are designations frequently used in on-site conversations, although a clear gender distinction is featured in the use of this terminology. The production of agricultural crops is what male individuals from peasant communities more often convey as self-reference, resulting in the preferred use of terms such as produtor (producer), produtor rural (rural producer), or agricultor. Adjectives related to the size of their operation are frequently incorporated as self-references by individuals positioned in the lower end of the spectrum (pequeno produtor = small producer) who also refer to themselves as lavradores (cultivators). The term agricultor has a wider connotation than the equivalent in English language, which is more often used in the scientific ambit. While agriculturalist refers to a particular technological package, agricultor is employed indiscriminately by a broad range of rural producers, from small-scale horticulturalists to capitalist farmers. In the study area, even though considering and referring to themselves as agricultores, producers that perform a system of shifting-cultivation resemble what is more often associated with horticulturalist technology.

Small producers may also allude to themselves as trabalhadores rurais (rural workers), an expression that distinctly embodies class connotation. Trabalhador rural, however, is an inclusive terminology widely used all over rural Brazil, not limited to

designate rural proletarians, what would probably be a more precise use of the term. Most of the subsistence-oriented, low-income domestic units of production also identify themselves as *trabalhadores rurais*. What better illustrates how broadly the term is employed in Brazil is the nation-wide, nested system of rural people's representation based on rural workers' unions and federations (*sindicatos e federações de trabalhadores rurais*). In addition, the MST (Movimento dos Trabalhadores Rurais Sem-Terra, the Landless Rural Workers' Movement) is perhaps Brazil's most active social movement.

Aside from these general productivist designations, primary activities performed by certain groups may turn representational categories into self-identification ones. Similar with the *seringueiros* (rubber-tappers) from Acre, *ribeirinhos* (river fishermen) from Amazonian floodplains, and *garimpeiros* (gold miners), this phenomenon occurs in Maranhão with *quebradeiras de côco babaçu* (babassu-nut cracker women), designated by an expression that stresses a unique gender component with relevant identity and political implications that transcend the economic domain. To be and to feel as a *quebradeira-de-côco* is a status that although acquired through shared experiences related to engaging in the extractive activity, does not require temporal continuity in such performance. Similar developments did not apply to any specific male-based agricultural production, and men refer to themselves using general terms as the ones already presented¹. Men do join (although secondarily in most cases) babassu-related activities, but it is mainly through the integration between male-based agricultural production and female-based babassu extraction, that the expression *agro-extrativista* (agro-extractive)

¹ Although the term *roça* is widely used in Maranhão to designate slash-and-burn swidden fields, I have observed that local people do not transfer the derivative of this terminology to their self-designation, as the term *roceiro* is distant from common usage.

has been recently employed to designate households and communities. Agro-extractive, however, remains an outsider's representation, mainly associated with those who are receptive to--and benefit from--conservation-oriented initiatives and discourses. The same applies to shifting-cultivator, an expression with no exact translation in Portuguese, although referring to the predominant type of agricultural technology in Maranhão.

As an aggregated group, however, references commonly used for self-designation by low income, small scale subsistence-oriented rural people in Lago do Junco include categories addressing features such as the contrast with urban environments (*povo do interior* = people from the countryside), the level of social organization (*povo das comunidades* = people from the communities), or their general economic orientation (*povo da roça* = people who cultivate the land). Moreover, strong processes of collective action for land tenure recovery resulted in the incorporation of the term *povo do mutirão* as a self-reference that highlights the notion of common reconstruction of important material and symbolic dimensions of their livelihood². *Mutirão*, in fact, is a designation that continues to be used even after communities regained tenure rights.

Fazendeiros are at the other extreme in the social configuration of rural Lago do Junco. In contemporary Brazil the term is interchangeably used with *pecuarista* (cattle raiser). Instead of farmers, which is closer to the word's literal translation,³ *fazendeiro* more appropriately designates ranchers (or cattle-owners). Indeed, distinct types of rural producers raise cattle, but not all them are considered ranchers due to a combination of aspects that include size of operation, activity diversification, economic and ideological

² *Mutirão* is a Portuguese term commonly referring to work parties for self-help housing in low-income urban neighborhoods.

orientations, and identity perspectives. The social and cultural presence of cattle herding within the region and beyond results in the fixation of *vaqueiro* as another category intrinsically linked to the activity. *Vaqueiros*, in effect, are more than cowboys that receive a wage to oversee cattle herds. They perform tasks that vary according to the type of enterprise, and are the strongest link between ranchers and social groups around the ranch. Moreover, *vaqueiros* incorporate several features of the activity in their daily life. So strong is their identification with the activity that in rural Maranhão a number of João *Vaqueiros*, Antonio *Vaqueiros*, and so forth, are basically individuals who assimilated the category into their own name, and frequently transfer the performance of the activity, and the nickname, to their descendants.

Farmer is a concept that gained relevant theoretical elaboration, and a concept of problematic application in analyses of the region, not only because of the immediate association with the translation *fazendeiro*. The complexity of the term also stems from farmer's primary perspective of producing for the market and obtaining profits through exchange-values. In addition, technological attributes that are often attached to what is commonly viewed as farming imply the use of more intensive methods, based either on labor or capital, than slash-and-burn. Soybean cultivators in southern Maranhão would be considered farmers according to the broad, English definition. In the Mearim Valley, only a minority of producers engaging in mechanized rice production could be referred as such.

³ The association of *fazendas* to ranches, however, is not generalized. As with Spanish *haciendas*, the term also refers to landed estates used for farming, such as coffee, cotton or sugarcane plantations in Brazil.

APPENDIX C REMOTE SENSING ANALYSIS

Data Considerations

Cloud-free images collected at the same time of the year for the different periods being considered are the ideal data for remote sensing analysis of land-cover change. Cloud-free images of the Brazilian Amazon, however, are a frequent constraint for multi-temporal analysis. Despite the 16-day temporal resolution of the Landsat sensors, the availability of cloud-free scenes for the study area during the entire 16-year period was limited to the ones that are included in this research. Although the seasonal compatibility of these images is not perfect, the images were acquired in the period between the end of the wet season and the onset of the dry season. The scenes were acquired on the following dates: on July 10, 2002; August 5, 2001; and May 14, 2000; by the Enhanced Thematic Mapper (ETM+) sensor on Landsat-7; and on August 4, 1986; by the Multispectral Scanner (MSS) of Landsat-5.

Geometric Correction

This procedure adjusts the data obtained with Landsat satellites, to the Universal Transverse Mercator (UTM) coordinate system. The corrections were applied to files that included 6 bands for the ETM+ scenes (bands 1 to 5, and band 7), and the 4 bands for the MSS scene. In ERDAS Imagine 8.5, the 2001 scene was initially registered to ground control points obtained with the GPS receiver, set to UTM zone 23, and based on the WGS-84 datum. The other scenes were geometrically corrected through the initial use of

20 evenly distributed ground control points (GCPs). Geometric resampling was performed to generate outputs with 30 x 30 meter pixels, applying the bilinear interpolation algorithm. The final number of ground control points, and the root-mean-square error (RMS) for image-to-image rectification are presented in Table C-1.

Table C-1. Ground control points and root-mean-square error for geographic correction

Image acquisition	Number of ground control points	RMS error
08.04.1986	8	0.3688
05.14.2000	4	0.4147
07.07.2002	10	0.3448

Radiometric Calibration

Radiometric calibration is performed to allow multi-temporal comparison of the data. Procedures aim to eliminate non-surface sources of variability: sensor related sources, illumination related sources (earth-Sun distance, solar zenith angle differences, solar irradiance differences with wavelength), and atmospheric sources. The radiometric calibration performed in this study followed the guidelines predicated by CIPEC's Summer Institute, with additional information provided by Glen Green (personal communication). Three steps were included in this process:

- Conversion of raw Landsat digital numbers (DNs) values to apparent at-sensor radiance value;
- Conversion of radiance values to apparent at-sensor reflectance values;
- Conversion of apparent at-sensor reflectance values to surface reflectance values.

The mathematical functions used to calibrate each band of the four scenes, for each of these steps, are in Table C-2. Additional information needed for radiometric calibration (solar elevation angle, minimum and maximum spectral values for each band, and minimum spectral values for the scenes' darkest object, a non-turbid lake) is reported in Table C-3.

Table C-2. Mathematical functions for radiometric correction

	Apparent radiance at the sensor [Wm ⁻² sr ⁻¹ mm ⁻¹]		At satellite reflectance = Rspace		At satellite reflectance * range factor		At satellite reflectance * range factor incorporating atmospheric correction	
2000	L ^{*1} = 0.786275	x dn1 -6.20	r ^{*1} = 0.001594	x dn1 -0.01257	r ^{*1} = 0.478097	x dn1 -3.76993	r ^{*1} = 0.478097	x dn1 -16.5077
May	L ^{*2} = 0.817255	x dn2 -6.00	r ^{*2} = 0.001771	x dn2 -0.01300	r ^{*2} = 0.531178	x dn2 -3.89972	r ^{*2} = 0.531178	x dn2 -2.07005
14	L ^{*3} = 0.639608	x dn3 -4.50	r ^{*3} = 0.001642	x dn3 -0.01156	r ^{*3} = 0.492710	x dn3 -3.46649	r ^{*3} = 0.492710	x dn3 -0.06503
	L ^{*4} = 0.939216	x dn4 -4.50	r ^{*4} = 0.003582	x dn4 -0.01716	r ^{*4} = 1.074550	x dn4 -5.14842	r ^{*4} = 1.074550	x dn4 -10.7155
	L ^{*5} = 0.128471	x dn5 -1.00	r ^{*5} = 0.002259	x dn5 -0.01758	r ^{*5} = 0.677633	x dn5 -5.27460	r ^{*5} = 0.677633	x dn5 -6.77633
	L ^{*6} = 0.044243	x dn7 -0.35	r ^{*7} = 0.002194	x dn7 -0.01735	r ^{*7} = 0.658106	x dn7 -5.20617	r ^{*7} = 0.658106	x dn7 -5.92296
2001	L ^{*1} = 0.775686	x dn1 -6.20	r ^{*1} = 0.001615	x dn1 -0.01290	r ^{*1} = 0.645805	x dn1 -5.16187	r ^{*1} = 0.645805	x dn1 -23.1483
Aug	L ^{*2} = 0.795686	x dn2 -6.40	r ^{*2} = 0.001770	x dn2 -0.01424	r ^{*2} = 0.708106	x dn2 -5.69555	r ^{*2} = 0.708106	x dn2 -9.83665
5	L ^{*3} = 0.619216	x dn3 -5.00	r ^{*3} = 0.001633	x dn3 -0.01318	r ^{*3} = 0.653120	x dn3 -5.27377	r ^{*3} = 0.653120	x dn3 -5.21985
	L ^{*4} = 0.637255	x dn4 -5.10	r ^{*4} = 0.002496	x dn4 -0.01997	r ^{*4} = 0.998270	x dn4 -7.98924	r ^{*4} = 0.998270	x dn4 -11.9392
	L ^{*5} = 0.125726	x dn5 -1.00	r ^{*5} = 0.002270	x dn5 -0.01806	r ^{*5} = 0.908004	x dn5 -7.22210	r ^{*5} = 0.908004	x dn5 -8.17204
	L ^{*6} = 0.043726	x dn7 -0.35	r ^{*7} = 0.002226	x dn7 -0.01782	r ^{*7} = 0.890551	x dn7 -7.12841	r ^{*7} = 0.890551	x dn7 -6.23386
2002	L ^{*1} = 0.775686	x dn1 -6.20	r ^{*1} = 0.001697	x dn1 -0.01356	r ^{*1} = 0.678786	x dn1 -5.42548	r ^{*1} = 0.678786	x dn1 -23.0908
Jul	L ^{*2} = 0.795686	x dn2 -6.40	r ^{*2} = 0.001861	x dn2 -0.01497	r ^{*2} = 0.744268	x dn2 -5.98642	r ^{*2} = 0.744268	x dn2 -8.45073
7	L ^{*3} = 0.619216	x dn3 -5.00	r ^{*3} = 0.001716	x dn3 -0.01386	r ^{*3} = 0.686475	x dn3 -5.54310	r ^{*3} = 0.686475	x dn3 -6.28719
	L ^{*4} = 0.637255	x dn4 -5.10	r ^{*4} = 0.002623	x dn4 -0.02099	r ^{*4} = 1.049251	x dn4 -8.39725	r ^{*4} = 1.049251	x dn4 -12.5510
	L ^{*5} = 0.125726	x dn5 -1.00	r ^{*5} = 0.002386	x dn5 -0.01898	r ^{*5} = 0.954375	x dn5 -7.59093	r ^{*5} = 0.954375	x dn5 -8.58938
	L ^{*6} = 0.043726	x dn7 -0.35	r ^{*7} = 0.002340	x dn7 -0.01873	r ^{*7} = 0.936031	x dn7 -7.49245	r ^{*7} = 0.936031	x dn7 -7.48824
1986	L ^{*1} = 2.086614	x dn, +3.00	r ^{*1} = 0.004699	x dn, +0.00676	r ^{*1} = 1.879675	x dn, +2.70248	r ^{*1} = 1.879675	x dn -14.4748
Aug	L ^{*2} = 1.385827	x dn, +3.00	r ^{*2} = 0.003618	x dn, +0.00783	r ^{*2} = 1.447191	x dn, +3.13284	r ^{*2} = 1.447191	x dn +3.95371
4	L ^{*3} = 1.220472	x dn, +4.00	r ^{*3} = 0.004056	x dn, +0.01329	r ^{*3} = 1.622387	x dn, +5.31724	r ^{*3} = 1.622387	x dn +2.70090
	L ^{*4} = 0.944882	x dn, +3.00	r ^{*4} = 0.004522	x dn, +0.01436	r ^{*4} = 1.808988	x dn, +5.74354	r ^{*4} = 1.808988	x dn +0.04

Table C-3. Additional data for radiometric calibration

	1986		2000		2001		2002	
Histogram	min	max	min	max	min	max	min	max
Band 1	12	32	50	150	55	91	52	90
Band 2	7	28	32	160	36	77	33	91
Band 3	2	60	23	120	33	83	23	86
Band 4	1	68	12	195	52	109	10	128
Band 5			10	240	55	136	9	178
Band 7			10	165	20	81	9	94
Solar elevation angle	51		53.53		52.09		48.95	
Darkest object								
Band 1	16		59		60		57	
Band 2	12		34		44		40	
Band 3	8		24		32		27	
Band 4	0		10		12		10	
Band 5			10		9		9	
Band 7			9		7		8	

Image Subset

Although initial procedures of the analysis required the use of entire scenes, the remainder of the method was applied to subsets. Landsat images cover a surface of over 33,000 km², which corresponds to approximately 49 million bits. The analysis of entire scenes results in unnecessary expenditure of time and resources. If the study site is located in a small area, the sub-setting of satellite scenes is recommended. Various scene subsets were produced in this study, for each of the periods being considered. The first and larger subset was a rectangular area of approximately 2,500 km² that included the municipalities of Lago do Junco and Lago dos Rodrigues, and the surrounding region. The second subset was limited to the area of Lago do Junco/Lago dos Rodrigues (approximately 600 km²). The third and smaller subset comprised only the communities of Pau Santo and São Manoel, with total area of approximately 50 km²). Six other subsets were produced: one for each of the five categories of landholdings (according to their size), and one for the settlement areas in the municipality. For the initial period covered by the analysis, 15 aerial photographs of 6 x 6 km each were obtained for the region,

including the areas of Pau Santo and São Manoel. Land-cover classification was applied to the larger area of 2,500 km². The classified image was used then to generate land-cover classifications for the smaller subsets.

Spectral Signatures

Geographical coordinates of 90 training sites (at least four for each subcategory) were initially used to define spectral signatures for categories of land-cover mentioned in Table 5-1. The remaining training sites were reserved for accuracy assessment. Small polygons, or “areas of interest” (AOIs) were drawn in Erdas Imagine based on these points. In order to define spectral classes, AOIs were expanded with the “seed growing” tool of Imagine, with euclidean distances of 5-8. Table C-4 shows the statistics for these signatures.

Table C-4. Statistics of original spectral signatures for land-cover classification

Category I.1: Gallery forest (236 pixels)										
	Min	Max	Mean	St.dev.	b1	b2	b3	b4	b5	b7
b1	13	17	14.5	0.7	b1	0.5				
b2	21	26	22.9	1.0	b2	0.3	1.0			
b3	12	19	14.2	1.1	b3	0.3	0.5	1.1		
b4	53	64	57.5	2.5	b4	-0.2	-0.1	-0.1	6.1	
b5	39	51	44.6	2.6	b5	-0.2	-0.3	-0.1	2.7	6.9
b7	12	19	15.4	1.4	b7	-0.1	0.0	0.1	1.0	2.5
Category I.2: Upland mature forest (184 pixels)										
	Min	Max	Mean	St.dev.	b1	b2	b3	b4	b5	b7
b1	12	16	13.8	0.6	b1	0.3				
b2	19	24	21.9	0.9	b2	0.2	0.9			
b3	11	17	13.5	1.1	b3	0.2	0.7	1.3		
b4	47	60	53.8	3.2	b4	-0.1	0.4	-0.1	10.2	
b5	36	46	40.7	2.3	b5	0.2	1.0	1.1	2.3	5.1
b7	11	17	14.1	0.9	b7	0.1	0.4	0.5	0.3	1.5
Category I.3: Advanced secondary forest (153 pixels)										
	Min	Max	Mean	St.dev.	b1	b2	b3	b4	b5	b7
b1	12	16	13.8	0.6	b1	0.3				
b2	20	25	22.3	0.9	b2	0.2	0.9			
b3	12	16	13.4	0.9	b3	0.1	0.5	0.8		
b4	58	71	63.7	3.3	b4	-0.1	0.1	0.0	10.7	
b5	41	52	45.8	2.9	b5	0.1	0.2	0.4	3.9	8.3
b7	13	19	15.5	1.3	b7	0.1	0.2	0.2	1.0	2.9

Table C-4. Continued

Table 6. Continued											
Category II.1: Intermed. second-growth (200 pixels)						covariance					
	Min	Max	Mean	St.dev.		b1	b2	b3	b4	b5	b7
b1	13	16	14.5	0.6	b1	0.4					
b2	22	25	23.5	1.0	b2	0.2	1.0				
b3	13	19	15.7	1.1	b3	0.2	0.6	1.3			
b4	43	54	49.5	2.3	b4	0.0	0.8	-0.1	5.3		
b5	36	47	41.8	2.2	b5	0.3	1.1	1.2	2.0	4.8	
b7	13	21	15.3	1.5	b7	0.3	0.6	0.9	0.1	2.5	2.4
Category II.2: Initial fallow stage (61 pixels)						covariance					
	Min	Max	Mean	St.dev.		b1	b2	b3	b4	b5	b7
b1	14	17	14.9	0.9	b1	0.9					
b2	24	28	25.3	1.2	b2	0.9	1.4				
b3	13	18	15.3	1.3	b3	1.0	1.4	1.8			
b4	69	78	72.1	2.4	b4	0.0	0.0	-0.1	5.6		
b5	49	59	54.4	2.6	b5	0.9	1.3	1.6	2.8	7.0	
b7	16	23	19.6	1.6	b7	0.8	0.8	1.2	1.1	3.3	2.7
Category III.1: Jaraguá + high palms (62 pixels)						covariance					
	Min	Max	Mean	St.dev.		b1	b2	b3	b4	b5	b7
b1	14	17	15.6	0.7	b1	0.4					
b2	23	28	25.3	0.7	b2	0.2	0.5				
b3	16	21	18.3	1.2	b3	0.3	0.3	1.4			
b4	51	62	57.4	2.5	b4	0.1	0.6	-1.3	6.1		
b5	52	63	57.2	2.8	b5	0.4	0.6	1.2	0.8	7.7	
b7	20	27	23.2	1.7	b7	0.2	0.3	0.9	0.0	4.2	3.0
Category III.2: Jaraguá + medium palms (100 pixels)						covariance					
	Min	Max	Mean	St.dev.		b1	b2	b3	b4	b5	b7
b1	14	16	15.2	0.7	b1	0.5					
b2	24	27	25.2	0.6	b2	0.0	0.3				
b3	15	19	17.4	0.9	b3	0.2	0.1	0.7			
b4	56	66	60.5	2.3	b4	0.1	0.4	-0.1	5.5		
b5	51	61	56.4	2.4	b5	0.3	0.4	1.0	1.6	5.8	
b7	18	24	21.0	1.4	b7	0.2	0.1	0.7	0.2	2.5	1.9
Category III.3: Jaraguá + low palms (135 pixels)						covariance					
	Min	Max	Mean	St.dev.		b1	b2	b3	b4	b5	b7
b1	14	18	16.1	0.8	b1	0.7					
b2	24	28	26.4	1.0	b2	0.3	0.9				
b3	17	25	19.9	1.2	b3	0.5	0.6	1.5			
b4	51	66	58.6	2.4	b4	0.0	0.6	0.1	5.7		
b5	55	67	60.9	2.4	b5	0.2	0.7	0.9	2.9	5.6	
b7	21	29	25.1	1.8	b7	0.2	0.5	1.0	1.1	3.1	3.2
Category III.3: Brachiaria + low palms (119 pixels)						covariance					
	Min	Max	Mean	St.dev.		b1	b2	b3	b4	b5	b7
b1	16	20	17.8	0.6	b1	0.4					
b2	28	32	30.2	1.0	b2	0.2	1.0				
b3	19	28	23.4	1.7	b3	0.3	0.5	3.0			
b4	60	75	66.5	2.9	b4	-0.1	1.1	-2.2	8.7		
b5	63	80	71.3	3.5	b5	0.5	0.3	4.4	-4.2	12.5	
b7	23	36	29.4	2.2	b7	0.2	-0.1	2.4	-3.4	6.3	4.8

Table C-4. Continued

Category IV.1: Brachiaria grass (110 pixels)										
	Min	Max	Mean	St.dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	14	18	16.2	0.8	b1	0.7				
b2	28	33	30.3	1.1	b2	0.3	1.3			
b3	18	25	20.2	1.3	b3	0.6	0.7	1.6		
b4	72	86	78.5	3.4	b4	-0.3	1.8	-0.7	11.5	
b5	58	70	63.1	2.2	b5	0.8	1.2	1.7	0.9	4.9
b7	19	27	22.8	1.9	b7	0.7	0.7	1.5	-1.1	3.0 3.8
Category IV.2: Jaraguá grass - no palms (100 pixels)										
	Min	Max	Mean	St.dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	14	18	16.0	0.6	b1	0.3				
b2	26	31	28.3	0.9	b2	0.2	0.9			
b3	17	21	18.6	0.9	b3	0.2	0.4	0.8		
b4	68	79	72.7	2.5	b4	0.3	1.4	0.3	6.4	
b5	58	70	64.6	2.8	b5	0.3	1.2	1.3	3.1	8.1
b7	21	28	24.6	1.4	b7	0.1	0.5	0.6	1.0	3.0 2.0
Category V.1: Bottomland tango grass (122 pixels)										
	Min	Max	Mean	St.dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	18	24	20.9	1.6	b1	2.6				
b2	30	40	34.6	2.4	b2	3.4	5.9			
b3	25	37	31.0	2.8	b3	3.7	6.0	7.9		
b4	59	79	69.5	3.6	b4	2.8	5.4	4.6	13.2	
b5	73	88	80.6	3.4	b5	0.3	0.6	1.5	1.2	11.4
b7	32	46	38.6	2.8	b7	1.5	2.5	4.3	0.8	6.8 8.0
Category V.2: Bottomland hard grass (100 pixels)										
	Min	Max	Mean	St.dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	16	19	17.5	0.8	b1	0.7				
b2	27	31	28.9	1.1	b2	0.4	1.1			
b3	20	25	23.1	1.2	b3	0.5	0.6	1.5		
b4	51	62	56.5	2.7	b4	0.2	1.4	-0.5	7.5	
b5	62	73	67.5	3.1	b5	0.9	0.9	1.4	1.3	9.4
b7	23	32	29.0	1.5	b7	0.2	0.3	0.7	-0.3	3.5 2.3
Category VI.1: Cropland recent slash (106 pixels)										
	Min	Max	Mean	St.dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	18	24	21.0	1.1	b1	1.3				
b2	29	36	31.7	1.4	b2	1.1	1.9			
b3	25	34	29.4	1.9	b3	1.4	1.9	3.6		
b4	49	62	56.1	2.9	b4	0.7	1.5	-0.2	8.2	
b5	78	96	86.9	4.4	b5	3.2	3.9	4.3	6.7	19.4
b7	39	52	45.7	3.2	b7	2.2	2.4	3.4	2.3	12.2 10.3
Category VI.2: Cropland, harvest period (94 pixels)										
	Min	Max	Mean	St.dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	15	20	17.3	0.9	b1	0.9				
b2	24	32	28.6	1.2	b2	0.6	1.5			
b3	17	26	21.7	1.8	b3	0.8	1.1	3.2		
b4	53	69	62.5	3.9	b4	0.1	0.8	-3.2	15.0	
b5	64	74	68.5	2.3	b5	0.8	1.1	1.5	0.3	5.2
b7	26	34	29.6	1.5	b7	0.3	0.2	1.3	-2.2	2.0 2.3

Table C-4. Continued

Category VII.1: Water reservoirs (95 pixels)					covariance					
	Min	Max	Mean	St.dev.	b1	b2	b3	b4	b5	b7
b1	12	15	13.3	0.8	b1	0.7				
b2	16	20	17.7	1.0	b2	0.1 0.9				
b3	10	15	12.6	0.9	b3	0.1 0.2	0.8			
b4	2	13	5.6	2.4	b4	0.1 0.8	0.6	5.8		
b5	2	12	5.6	1.8	b5	0.1 0.8	0.4	2.1	3.4	
b7	1	7	3.3	1.2	b7	-0.1 0.2	0.2	0.8	1.2	1.5
Category VII.2: Water streams (105 pixels)					covariance					
	Min	Max	Mean	St.dev.	b1	b2	b3	b4	b5	b7
b1	14	21	17.7	1.3	b1	1.7				
b2	22	30	27.4	1.7	b2	1.6 2.9				
b3	15	25	20.1	2.0	b3	1.9 2.8	4.1			
b4	11	47	29.7	7.5	b4	-6.1 -6.7	-11.1	56.0		
b5	8	37	23.0	6.2	b5	-3.4 -4.1	-6.7	35.9	38.6	
b7	2	16	9.3	2.5	b7	-1.0 -1.4	-2.1	11.5	14.5	6.6
Category VIII: Bare soil, gravel roads (167 pixels)					covariance					
	Min	Max	Mean	St.dev.	b1	b2	b3	b4	b5	b7
b1	17	27	21.6	2.1	b1	4.7				
b2	28	42	34.4	2.9	b2	5.7 8.6				
b3	23	54	35.1	7.0	b3	12.4 18.0	48.9			
b4	55	79	66.3	4.5	b4	-0.3 1.2	-3.5	19.9		
b5	80	118	93.5	8.7	b5	11.5 15.7	37.5	-1.7	75.3	
b7	35	78	53.9	9.3	b7	12.8 17.7	49.4	-7.5	70.5	87.2

Supervised Classification

All subcategories were initially used to produce a supervised classification of the 2002 image. The transformed divergence test for the statistical analysis of signatures indicated overlaps for subcategories of palm/pasture associations, species-rich forests, and open pastures. Appropriate levels of separability were obtained with the aggregation of these subcategories, and the masking out of certain classes, as explained next.

The normalized difference vegetation index (NDVI) was computed for the 2000, 2001, and 2002 subsets. Through the subtraction of indices between image pairs (2002/2001, and 2001/2000), areas with higher NDVI increases and decreases for each period were defined. Assuming that no new pastures were formed after recent deforestation in the area, this method allowed to identify areas recently cut for agriculture

(higher NDVI decrease in 2002); areas that were cropped in 2001, and regrowing in 2002 (higher NDVI decrease in 2001); and areas cropped in 2000, and regrowing in 2001 (higher NDVI increase in 2001). These subcategories were then added and masked out of the 2002 scene, to reduce the confusion among cropland, pastures, and bare soil.

The remaining subcategories were aggregated up to their larger order: water, bare soil, bottomland open pasture, upland open pasture, pasture/palm associations, initial fallow, and mature forest/advanced succession. Satisfactory transformed divergence results were obtained (average separability of 1988, and minimum separability of 1897). Yet, less than 50% accuracy was achieved to distinguish between bottomland and upland open pasture. The process was then repeated, with the aggregation of all open pastures. Parametric (two variations of parallelepiped) and non-parametric methods (maximum likelihood and minimum distance) were employed. Table C-5 shows the statistics for these signatures, while Table C-6 shows the test for their separability.

The masked area of cropland (slashed and harvested), and initial fallow was then overlaid to the classified image. Subsequently, mature forests were disaggregated from advanced secondary growth by applying a 2-class unsupervised classification and computing NDVI, with better results provided by the latter method. As water and bare soil represented a small proportion of the area, accuracy assessment prioritized the vegetation classes. Despite adequate separability (transformed divergence test), the distinctions between certain pairs of categories did not achieve the expected level. Overall classification accuracy was only 65%, and several classes presented less than 60% accuracy (Table C-7). This lower accuracy, and the poor results when using 2002 signatures to the 1986 image suggested the application of an alternative approach.

Table C-5. Statistics of 6 spectral signatures after grouping subcategories

Category 1: Water (200 pixels)										
	Min	Max	Mean	St.Dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	12	21	15.6	2.5	b1	6.2				
b2	16	30	22.8	5.1	b2	11.8	25.7			
b3	10	25	16.6	4.1	b3	9.6	20.0	16.9		
b4	2	47	18.3	13.3	b4	24.0	55.7	40.2	177.8	
b5	2	36	14.7	9.9	b5	17.8	40.6	29.7	125.0	97.8
b7	1	16	6.5	3.6	b7	6.2	14.0	10.4	42.7	34.4 13.2
Category 2: Bare soil, gravel roads (167 pixels)										
	Min	Max	Mean	St.Dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	17	27	21.6	2.1	b1	4.7				
b2	28	42	34.4	2.9	b2	5.7	8.6			
b3	23	54	35.1	7.0	b3	12.4	18.0	48.9		
b4	55	79	66.3	4.5	b4	-0.3	1.2	-3.5	19.9	
b5	80	118	93.5	8.7	b5	11.5	15.7	37.5	-1.7	75.3
b7	35	78	53.9	9.3	b7	12.8	17.7	49.4	-7.5	70.5 87.2
Category 3: Open pasture (513 pixels)										
	Min	Max	Mean	St.Dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	14	24	17.8	2.1	b1	4.6				
b2	26	40	30.7	2.7	b2	5.0	7.5			
b3	17	37	23.6	4.8	b3	9.6	11.5	23.5		
b4	51	86	69.8	7.2	b4	-3.1	3.2	-8.3	51.4	
b5	58	88	70.0	7.3	b5	12.9	14.3	31.0	-13.7	53.2
b7	19	46	29.2	6.2	b7	11.6	12.5	27.8	-15.9	43.1 38.8
Category 4: Pasture/palm associations (397 pixels)										
	Min	Max	Mean	St.Dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	14	18	15.7	0.8	b1	0.7				
b2	23	28	25.6	0.9	b2	0.3	0.9			
b3	15	25	18.7	1.4	b3	0.6	0.8	2.1		
b4	51	66	58.4	2.7	b4	-0.1	0.5	-0.7	7.1	
b5	51	67	58.7	3.1	b5	0.9	1.4	2.8	0.7	9.5
b7	18	29	23.4	2.2	b7	0.7	1.0	2.2	-0.7	5.8 5.0
Category 5: Initial second-growth (61 pixels)										
	Min	Max	Mean	St.Dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	13	17	14.7	0.9	b1	0.9				
b2	22	28	24.6	1.3	b2	0.6	1.7			
b3	13	18	15.2	1.2	b3	0.7	0.8	1.5		
b4	64	78	70.2	3.0	b4	0.5	0.4	-0.4	9.0	
b5	47	59	53.1	2.8	b5	0.7	1.8	0.9	4.6	8.1
b7	16	23	18.2	1.5	b7	0.6	0.9	0.7	1.1	3.0 2.4
Category 6: Advanced secondary forest (773 pixels)										
	Min	Max	Mean	St.Dev.		b1	b2	covariance		
						b3	b4	b5	b7	
b1	12	17	14.2	0.7	b1	0.5				
b2	19	26	22.7	1.1	b2	0.4	1.3			
b3	11	19	14.3	1.4	b3	0.5	1.1	2.0		
b4	43	71	55.8	5.7	b4	-0.8	-1.2	-3.4	32.1	
b5	36	52	43.2	3.2	b5	0.1	0.5	0.1	11.0	10.2
b7	11	21	15.1	1.4	b7	0.2	0.5	0.6	1.5	3.1 2.0

Table C-6. Transformed divergence test for signature separability using bands 1-5, and 7

Land-cover category		Class pairs	Best minimum separability	Best average separability
1	Initial fallow	1:2	2000	2000
2	Bare soil	1:3	1982	1982
3	Pasture/palm associations	1:4	2000	2000
4	Water	1:5	1897	1897
5	Forest/advanced sec. growth	1:6	1999	1999
6	Open pasture	2:3	2000	2000
		2:4	2000	2000
		2:5	2000	2000
		2:6	1968	1968
		3:4	2000	2000
		3:5	1980	1980
		3:6	1978	1978
		4:5	2000	2000
		4:6	2000	2000
		5:6	2000	2000

Table C-7. Accuracy assessment for supervised land-cover classification (minimum distance algorithm)

Land-cover classes	Water	Bare ground	Open pasture	Pasture/palm	Second- growth	Mature forest	Cropland	Total	% accuracy	Total accuracy
Water	15							15		1
Bare ground		20	3	1				24	0.83	
Open		10	132	31	6		12	191	0.69	
Past./palm			5	27	120	16	15	10	193	0.62
Sec. growth	1			17	2	72	6	1	99	0.73
Forest	1				12	10	126	1	150	0.84
Cropland	12		22	29			1	22	86	0.26
Total	29	35	201	195	104	148	46	694		
% accuracy	0.52	0.57	0.66	0.62	0.69	0.85	0.48			64.7%

The second approach used consisted of an unsupervised classification, with the benefit of reference data obtained for supervised methods. The approach, which I named "informed unsupervised classification," focused on the gradual definition of a 6-category classification scheme that excluded cropland, joined forest remnants and advanced secondary succession, and merged the two types of open pasture. The approach is explained next.

Informed Unsupervised Classification

The objective of this method was to provide 1986 and 2002 classified scenes with 6 categories of land-cover: water, bare ground, open pasture, palm/pasture associations, recent fallow/intermediate second-growth, and advanced second-growth/mature forest.

Unsupervised Classification of the 2002 Scene

Before applying an unsupervised classification to the 2002 scene, ground control points were used to single out areas of water and bare ground. Approximately 2% of the scene subset was classified in these two categories using the parallelepiped method (overlap by order, unclassified pixels assigned to none). After recoding the classified image and masking out the pixels comprised by these classes, an 8-class unsupervised classification was applied to the remaining data (10 iterations; 98% threshold). The classified image was examined in respect to 90 ground control points collected during fieldwork (the same points used in the supervised classification attempt), and the eight classes were assigned to the range of land-cover types that they were likely to comprise, as shown in Table C-8.

Table C-8. Range of 2002 land-cover types assigned after first unsupervised classification

Class	Forest	Second-growth	Palm/pasture	Open pasture	Bare ground	Water
1	✓	✓				✓
2	✓	✓	✓			
3		✓	✓			
4			✓			
5				✓		
6				✓		
7			✓			
8				✓	✓	

The comparison with ground control points has indicated that all pixels in classes 5 and 6 should be assigned to "open pasture." Similarly, all pixels in classes 4 and 7 were

assigned to the "palm/pasture" land-cover type. By recoding the classified scene, the areas corresponding to each of the remaining four classes were used to generate masks in the original scene. Further unsupervised classifications (8 iterations; 98% threshold) were then applied to each of these four subsets. Although in certain cases the number of classes set for unsupervised classifications corresponded to the range of land-cover types observed for this class, the use of a larger number of classes is likely to improve classification accuracy. For example, 3- and 4-class unsupervised classifications were respectively applied to the masked scenes for classes 3 and 8, despite the fact that both of these scenes comprised only two land-cover types. The examination of each sub-class led to the final assignment of land-cover types through recoding procedures. The final assignment of unique codes to the six land-cover types enabled the overlay of the nine classified masked scenes, and the obtaining of a final, composed land-cover classification. Classification accuracy was assessed through the error matrix presented in Table C-9. Overall classification accuracy was greater than 70%, and only in one case individual accuracy was lower than 60%. Procedures used for the classification of the 2002 scene are summarized in Figure C-1.

Table C-9. Accuracy assessment for 2002 "informed" unsupervised classification

Land-cover classes	Water	Bare ground	Open pasture	Second /palm	Mature growth	Forest	Total	% accuracy	Total accuracy
Water	77						77	100.0%	
Bare ground	13	196	8	32		3	252	77.8%	
Open pasture		10	264	43	19	3	339	77.9%	
Pasture/palm		35	21	185			241	76.8%	
Sec. growth	6		14	3	69	36	128	53.9%	
Forest	3		3		22	112	140	80.0%	
Total	99	241	310	263	110	154	1177		71.0%
% accuracy	77.8%	81.3%	85.2%	70.3%	62.7%	72.7%			

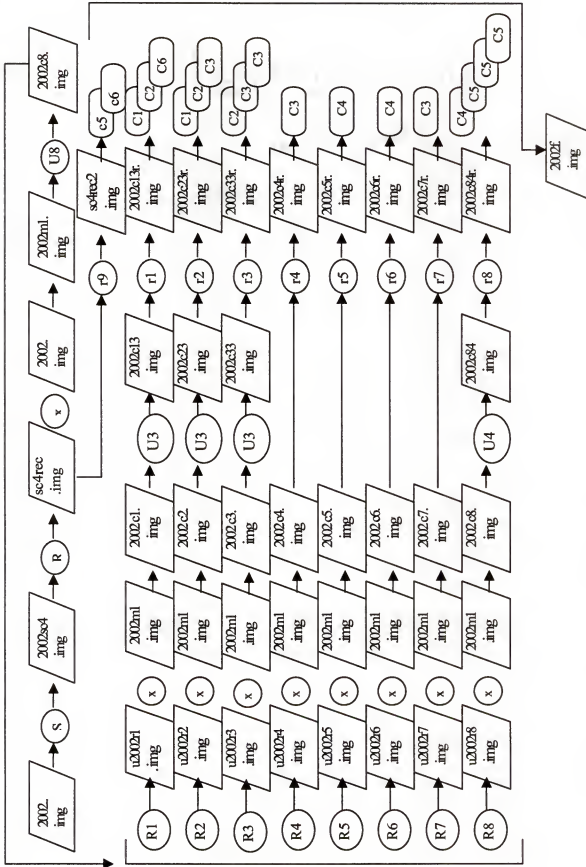


Figure C-1. Procedures for "informed" unsupervised classification of 2002 scene (R = recode; U = unsupervised classification; S = supervised classification; C = land-cover class; x = multiplication of scenes)

Unsupervised Classification of the 1986 Scene

A 10-class unsupervised classification (10 iterations; 98% threshold) was directly applied to the 1986 (MSS) image. The classified image was examined in respect to 190 reference points obtained from 1985 aerial photography. The 10 classes were assigned to the range of land-cover types that they were likely to comprise, as shown in Table C-10.

Table C-10. Range of 1986 land-cover types assigned after unsupervised classification

Class	Forest	Second- growth	Palm/ pasture	Open pasture	Bare ground	Water
1	✓				✓	✓
2	✓	✓	✓			
3			✓	✓		
4		✓	✓			
5	✓	✓	✓			
6			✓	✓		
7			✓	✓	✓	
8			✓	✓	✓	
9	✓	✓	✓	✓		
10	✓	✓			✓	

The comparison with reference data indicated that, contrary to the 2002 scene, no class was assigned to a single land-cover type. Informed by aerial photography, further 5-class unsupervised classifications (10 iterations; 98% threshold) were applied to 10 masked scenes obtained after recoding each of the 10 classes of the 1986 scene. Even though none of the classes was assigned to more than four land-cover types, a larger number of sub-classes was set to improve classification accuracy. As for the 2002 scene, the examination of each subclass led to the final assignment of land-cover types through recoding procedures; to the overlay of the 10 classified masked scenes; and to a final land-cover classification. Procedures adopted for the classification of the 1986 scene are summarized in Figure C-2. Classification accuracy was assessed through the error matrix presented in Table C-11.

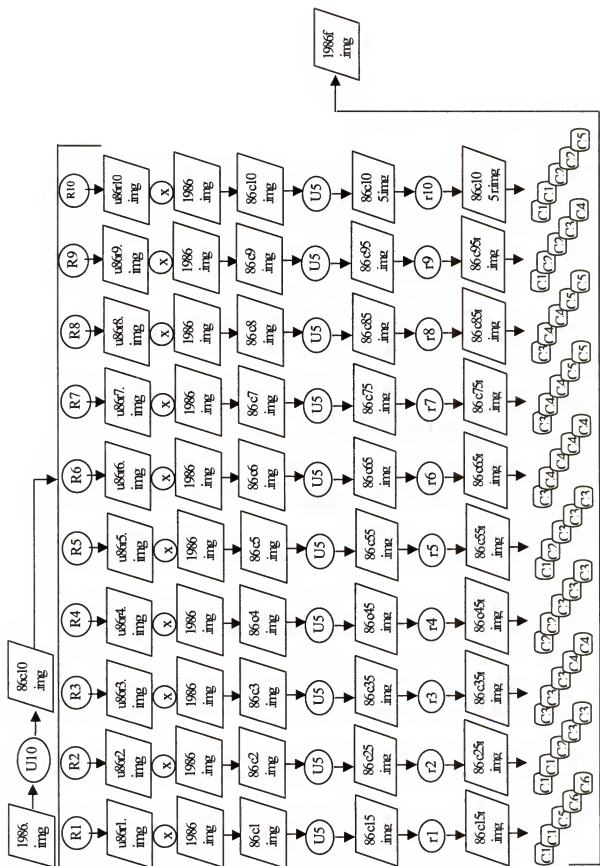


Figure C-2. Procedures for "informed" unsupervised classification of 1986 scene

Table C-11. Accuracy assessment for 1986 "informed" unsupervised classification

Land-cover classes	Water	Bare ground	Open pasture	Pasture /palm	Second growth	Mature Forest	Total	% accuracy	Total accuracy
Water	88					6	94	93.6%	
Bare ground	3	92	14	6	3		118	78.0%	
Open pasture		6	81	19	2		108	75.0%	
Pasture/palm		2	21	89	11	11	134	66.4%	
Sec. growth	1	4	5	11	85	8	114	74.6%	
Forest	7			4	12	90	113	79.6%	
Total	99	104	121	129	113	115	681		72.5%
% accuracy	88.9%	88.5%	66.9%	69.0%	75.2%	78.3%			

APPENDIX D INDICES AND CALCULATIONS

Table D-1. Productive assets index

Bull	Cow	Steer	Heifer	Calf	Horse	Burro	Donkey	Swine 50 kg	Swine 5 kg
600	400	250	250	100	500	500	50	100	20
Chicken	Chick	Poultry adult	Poultry chick	Banana	Papaya	Passion fruit	Pine- apple	Other fruit tree	Ha pasture
5	1	10	3	5	3	3	3	7	50

Note: Market values in Brazilian currency (September 1, 2001: 1BR R\$ = 0.39 US\$).

Table D-2. Utensils/consumer goods index

Motorcycle 125cc used	Color tv	Satellite Dish	B&w tv	Refrig.	Gas stove	Sewing machine	Sound system	Bicycle	Radio	Clock
2,000	600	500	300	800	300	250	200	300	50	50

Note: Market values in Brazilian currency (September 1, 2001: 1BR R\$ = 0.39 US\$).

Table D-3. Housing index

Filter	Latrine	Well	Tapped water	Electr.	Porch	Raised garden	Size sq.m	Internal divisions	Wall	Roof	Floor	Size of yard
yes							# * 1	brick	tile	cement		Size
50	100	50	100	50	50	50	*1	100	100	100	* 0.001	
no								wattle	thatch	dirt		
0	0	0	0	0	0	0		50	50	50		

Table D-4. Market value of main agricultural products, and basic household supplies in Pau Santo and São Manoel (BR R\$ of September 2001)

Rice (kg)	Maize (kg)	Manioc flour (kg)	Beans (kg)	Babassu kernels (kg)	Babassu charcoal (5 kg)	Babassu oil (liter)	Banana 100 u.	Oranges 100 u.
0.60	0.25	0.70	1.50	0.60	1.00	2.00	3.00	5.00
Milk (liter)	Beef (kg)	Pork (kg)	Chicken (kg)	Fish (kg)	Eggs (dozen)	Sugar (kg)	Coffee (500g)	Soy oil (liter)
0.50	3.00	2.00	2.00	1.50	1.20	0.75	2.00	1.50

Table D-5. Household adult-equivalents for consumption

Age	Male	Female
0-1	0.1	0.1
2-3	0.2	0.2
4-5	0.3	0.3
6-7	0.4	0.4
8-9	0.5	0.5
10-11	0.6	0.55
12-13	0.7	0.6
14-15	0.8	0.65
16-17	0.9	0.7
18-60	1	0.8
61-64	0.9	0.7
65-68	0.8	0.65
69-72	0.7	0.6
73-76	0.6	0.55
77-80	0.5	0.5
>80	0.25	0.25

Table D-6. Calculation of gini-coefficient for monetary income

	Cases by groups of monetary income										Total
	0-250	251-500	501-1000	1001-2000	2001-3000	3001-4000	4001-5000	5001-7500	7501-15000	> 15000	
Total	15	21	41	50	40	24	12	15	7	1	226
Pau Santo	11	11	20	20	21	14	7	5	1	0	110
S. Manoel	4	10	21	30	19	10	5	10	6	1	116

	Proportion of cases by groups of monetary income										Total
	0-250	251-500	501-1000	1001-2000	2001-3000	3001-4000	4001-5000	5001-7500	7501-15000	> 15000	
Total	0.066	0.093	0.181	0.221	0.177	0.106	0.053	0.066	0.031	0.004	1
Pau Santo	0.100	0.100	0.182	0.182	0.191	0.127	0.064	0.045	0.009	0.000	1
S. Manoel	0.034	0.086	0.181	0.259	0.164	0.086	0.043	0.086	0.052	0.009	1

	Cumulative proportion / cases by groups of monetary income (%)										Total
	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	
Total	0.00	0.04	0.10	0.15	0.26	0.44	0.66	0.84	0.93	1.00	
Pau Santo	0.00	0.01	0.05	0.12	0.25	0.44	0.62	0.80	0.90	1.00	
S. Manoel	0.01	0.06	0.15	0.19	0.28	0.44	0.70	0.88	0.97	1.00	

	Total income by groups of monetary income										Total
	0-250	251-500	501-1000	1001-2000	2001-3000	3001-4000	4001-5000	5001-7500	7501-15000	> 15000	
Total	2,397	7,869	31,229	68,732	99,367	81,551	54,647	85,965	61,695	21,287	514,739
P. Santo	1,776	4,164	15,727	27,019	52,676	48,206	31,672	29,804	10,724	0	221,766
S.Manoel	621	3,705	15,502	41,714	46,691	33,346	22,975	56,161	50,971	21,287	292,974

Table D-6. Continued

	Proportion of monetary income										Total
	0-250	251-500	501-1000	1001-2000	2001-3000	3001-4000	4001-5000	5001-7500	7501-15000	> 15000	
Total	0.005	0.015	0.061	0.134	0.193	0.158	0.106	0.167	0.120	0.041	1.000
Pau Santo	0.008	0.019	0.071	0.122	0.238	0.217	0.143	0.134	0.048	0.000	1.000
S. Manoel	0.002	0.013	0.053	0.142	0.159	0.114	0.078	0.192	0.174	0.073	1.000

	Cumulative proportion / monetary income (%)										
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	
Total	0.04	0.16	0.33	0.43	0.59	0.79	0.92	0.98	1.00	1.00	
Pau Santo	0.00	0.05	0.18	0.33	0.54	0.78	0.90	0.97	0.99	1.00	
S. Manoel	0.07	0.25	0.44	0.52	0.63	0.79	0.93	0.99	1.00	1.00	

	(Xn) * (Yn+1)										sum x
	x1*y2	x2*y3	x3*y4	x4*y5	x5*y6	x6*y7	x7*y8	x8*y9	x9*y10	x10*0	
total	0.001	0.016	0.051	0.113	0.260	0.518	0.773	0.915	0.995	0.000	3.643
Pau Santo	0.000	0.003	0.022	0.080	0.237	0.482	0.722	0.876	0.992	0.000	3.413
S. Manoel	0.004	0.036	0.083	0.143	0.277	0.552	0.820	0.951	0.998	0.000	3.864

	(Yn) * (Xn+1)										sum y
	y1*x2	y2*x3	y3*x4	y4*x5	y5*x6	y6*x7	y7*x8	y8*x9	y9*x10	y10*x0	
Total	0.001	0.012	0.044	0.092	0.205	0.403	0.646	0.837	0.934	0.000	3.173
Pau Santo	0.000	0.002	0.018	0.064	0.192	0.394	0.602	0.794	0.900	0.000	2.964
S. Manoel	0.002	0.026	0.076	0.120	0.218	0.410	0.688	0.877	0.966	0.000	3.383

GINI monetary = sum x - sum y

Total	0.470
Pau Santo	0.449
S.Manoel	0.481

APPENDIX E

GENEALOGIES FOR EXTENDED FAMILIES IN SÃO MANOEL

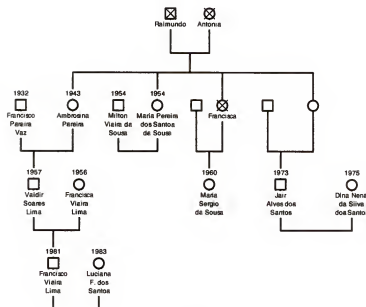


Figure E-1. Pereira family genealogy

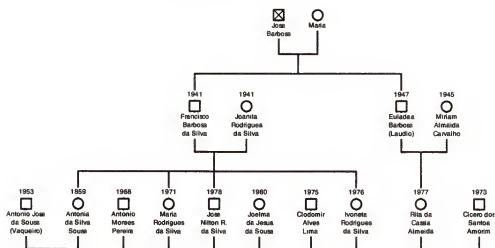


Figure E-2. Barbosa family genealogy

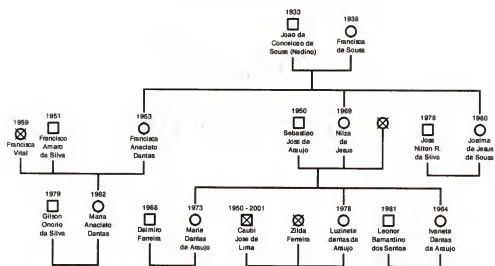


Figure E-3. Nedino family genealogy

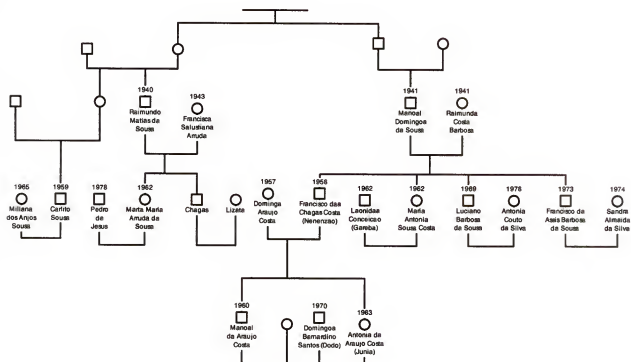


Figure E-4. Souza family genealogy

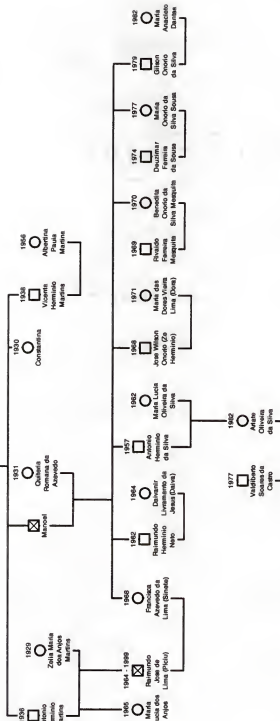


Figure E-5. Herminio family genealogy

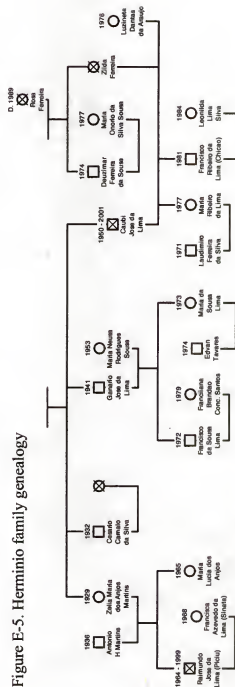


Figure E-6. Lima family genealogy

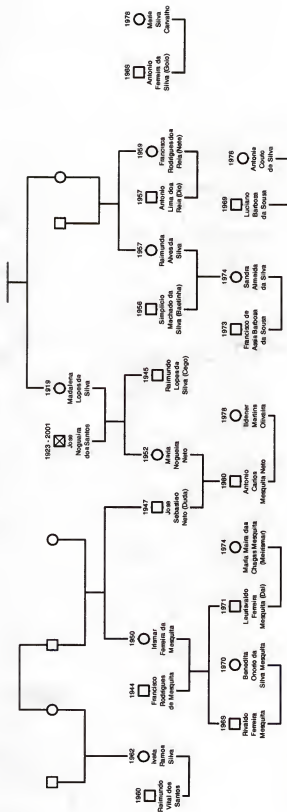


Figure E-7. Nogueira family genealogy

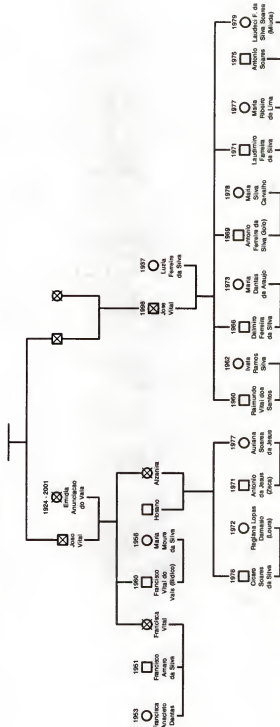


Figure E-8. Vital family genealogy

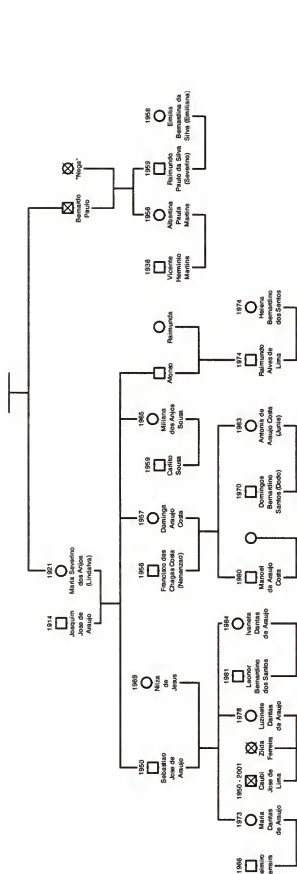


Figure E-9. Araújo family genealogy

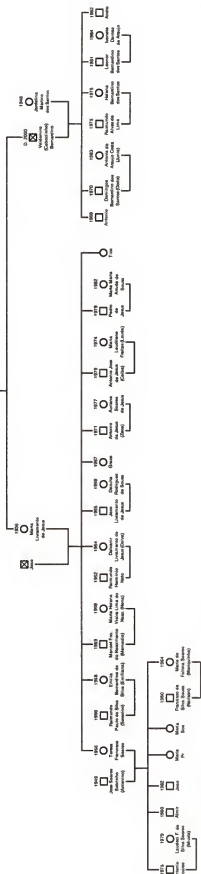


Figure E-10. Livramento family genealogy

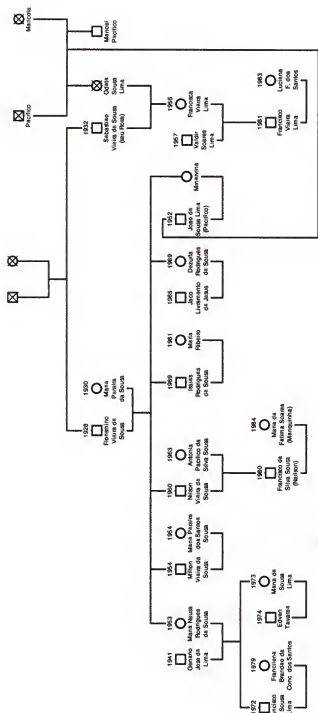


Figure E-11. Vieira family genealogy

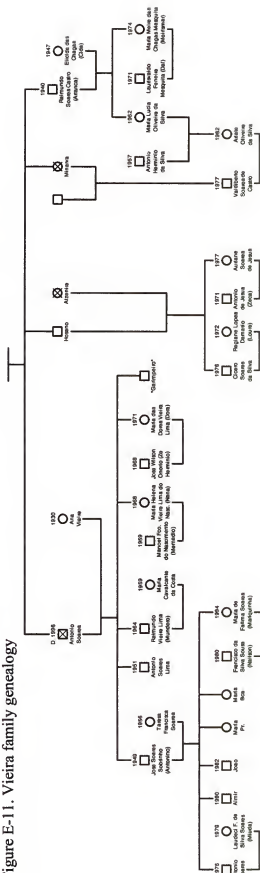


Figure E-12. Soares family genealogy

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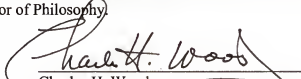
BIOGRAPHICAL SKETCH

Roberto Porro was trained as an agronomist. He graduated from University of São Paulo, Brazil, in 1985. Between 1986 and 1994, he worked as a practitioner with nongovernmental organizations in north and northeast Brazil. In 1989 he helped to create ASSEMA, an organization that focuses on property rights and conservation and development projects in the babassu palm zone in the state of Maranhão. Porro attended a program in Public Policy at the LBJ School of Public Affairs at the University of Texas (1994-1995). In 1997 he received a master's degree from the Center for Latin American Studies at the University of Florida, with concentration in Tropical Conservation and Development. For the completion of his graduate studies in Florida, he received fellowships from the Inter-American Foundation, the Nature and Society program of World Wildlife Fund Brazil, the Compton Foundation, and the Tropical Conservation and Development Program at UF. Since 2000 he has been part of the research project "Cattle Ranching, Land Use, and Deforestation in the Amazon: A Comparative Study of Brazil, Peru, and Ecuador," funded by the Inter-American Institute for Global Change Research, and carried out through UF's Center for Latin American Studies. Porro is co-editor--with Charles H. Wood--of "Deforestation and Land Use in the Amazon" (University Press of Florida 2002). His areas of specialization include economic anthropology, environmental anthropology, and anthropology of development

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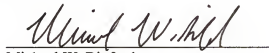
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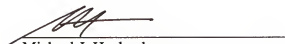
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This dissertation was submitted to the Graduate Faculty of the Department of Anthropology in the College of Liberal Arts and Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 2002

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